

Preventive Dentistry
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Lec. 19: Oral Immune System

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This system is of importance in *the prevention or limitation of microbial colonization* and *prevention of noxious substances to penetrate through oral mucosa*. It includes non –specific (innate) and specific (acquired) immune system.

Non- specific immune system:

The non- specific one lack any immunologic memory and not subjected to specific stimulations. They are helping factors for the specific immune system. It may interact with the specific salivary immune factors (immunoglobulin) resulting in amplification in respect to their activities.

Types:

- ***Lysozyme enzymes***; Arise from both major and minor salivary glands, gingival crevicular fluid and salivary leukocytes and may exert the anti-microbial effect even before teeth eruption. In addition to saliva it can be found in all body secretions as tears, nasal secretions etc.

They are hydrolytic enzymes cause lyses of Gram's positive and Gram's negative bacteria by hydrolyzing specific bonds in bacterial cell walls. It also aggregates cell suspensions of some bacterial species. In addition this enzyme may enhance the action of IgA.

- ***Sialoperoxidase (lactoperoxidase system)***; Peroxidase enzyme catalyzes the reaction of some bacterial products as hydrogen peroxide (H_2O_2) with thiocyanate to produce hypothiocynate, the hypothiocynate is toxic to bacteria. This system protects human host protein and cells from hydrogen peroxide toxicity. This system may interfere with metabolism of bacteria (glycolysis).

- ***Lactoferrin***; is a glycoprotein with 10% carbohydrate acts by chelation of iron the essential nutrient to microorganisms (nutritional

immunity). Unbounded lactoferrin has a direct bactericidal effect on some microorganism.

- **Mucins**; a glycoprotein that affects viscosity of saliva thus clearance of food. Some studies showed that increase viscosity of saliva may reduce the clearance activity of saliva thus increase caries severity. Mucins may cause also agglutination of microorganisms and inhibit the adhesions of bacteria to oral mucosa. While other studies reported the opposite as mucins may mediate specific bacterial adhesion to the tooth surface.

- **Proteins**; as statherins, prolin rich protein (PRPs), and histatins these found in the acquired pellicle but their origin are from saliva. They aid in remineralization of teeth by inhibition of calcium - phosphate crystals growth (i.e. reduce calculus formation).

Statherins: present in both submandibular and parotid saliva prevent precipitation of calcium phosphate in ductal saliva and oral fluids to maintain super saturations, prevent the formation of ductal stones and calcium phosphate crystals growth on tooth surfaces. It is degraded by proteases from oral microflora.

Prolin rich proteins: The inhibitory activity of (PRPs) can be explained by their adsorption to selectively mediate bacterial adhesion on tooth surfaces, they are strongly enhancing the adsorption of certain strains of *Actinomyces viscosus*.

Histatins: small histidin- rich proteins a potent inhibitors of *Candida albicans* and act against mutans streptococci. It modulates the precipitations of calcium phosphates.

Specific Immune System:

This system acts by action of immunoglobulins as IgA, IgG, IgM, IgD and IgE. In normal condition the only immunoglobulin found in saliva is s-IgA (; secretory immunoglobulin A). While in presence of gingival inflammation and through gingival exudates serum Immunoglobulins can be found as IgG, IgA, IgM and IgD.

The difference between serum and secretory IgA is the presence of additional glycoprotein referred as secretory components (; **Sc**). The IgA is synthesized by immunocytes cells (plasma cells and mast cells) while the Sc components originated in the glandular secretory epithelium. The s-IgA is

also found in tears, genital urinary secretions, bronchial secretions and breast milk.

Immunoglobulin IgG: It is the predominant immunoglobulin in blood, lymph, peritoneal fluid and cerebrospinal fluid. It accounts for approximately 75% of the total serum immunoglobulins in normal adults and is the most abundant antibody produced during secondary humoral immune response in the blood. IgG is the only class of immunoglobulin that can cross the placenta in humans, and it is responsible for protection of the new born during the first months of life.

General functions of immunoglobulin in relation to dental caries: are by elimination of microorganisms from the oral cavity and by interference with the cariogenic potential of these bacteria. This by;

- 1- Inhibitions of bacterial adherence through blocking of adherence determinants, or by agglutination of bacteria.
- 2- Inhibition of bacterial enzyme systems.
- 3- IgA has anti- inflammatory action in mucosal tissues. While IgG has the ability of bacteriolysis and induction of inflammations through chemotaxis and opsonization of bacteria in addition phagocytosis by poly morph nuclear leucocytes.

Immunoglobuline may transfer to the infants by breast feeding. The infant may receive as 1 g/ day of s- IgA. It interferes with the establishment of mutans streptococci in the earliest part of life.

Note: Secretory IgA is able to bind to surface **adhesins** of bacteria as well as to neutralize their negative surface charge. The end result is prevent adherence of bacteria to tooth surface.



Immunization of dental caries:

The mouth is under the influence of oral immune system involving humeral immunity by immunoglobulins (salivary or serum) and cellular by actions of poly morph nuclear leucocytes enter the oral cavity via gingival exudates. Studies showed that the indigenous flora can survive the immune system. This is of importance to design the immunological control of an oral population.

Immunization is a process involve exposing the host to an antigen (as killed or attenuated forms of microorganism) in order to stimulate antibodies of immunological memories. This was started in 1930 using Lactobacilli as

immunogene. After the redetection mutans streptococci in 60's of the last century they became the target in the experiments.

Vaccination; is a preventive measure by which a susceptible host is artificially prepared to resist infections. The antigen should provide a maximum preventive activity with minimum undesirable side effects.

Host + antigen  Stimulation of antibodies  Reduce dental caries

Different types of antigen can be used as; the whole bacterial cell as *S. mutans*, glucosyltransferase enzyme, cell wall protein, dextran-binding protein etc. In *experimental animals* there are different routes of immunization either by:

- **Direct stimulations of s-IgA** through repeated injections of the animal in vicinity of each parotid and /or sub mandibular gland with an antigen vaccine.

- **Indirect stimulation** of s- IgA: By feeding the animal the antigen, causes an indirect stimulation of s-IgA. The antigen when come in contact with the gut associated lymphoid tissue (GALT) in particular Payer's patches in the small intestine will stimulate antibodies (s- IgA), secreted in saliva, tears and milk.

- **Stimulation of serum immunoglobulin:** by subcutaneous injection of the animal by the selected antigen to stimulate serum immunoglobulin, like IgG, and to lesser extent IgM, IgA. Immunoglobulins reach oral cavity mainly by transduction with crevicular fluid.

The most important thing in selecting the vaccine ie antigen is its safety, effectiveness and long effect.

Serum antibodies (immunoglobulin) may be an effective approach to vaccinations but there is a possibility of cross reactions with the heart muscles. *S. mutans* possess an antigen component that stimulate the cross react with heart muscles. The stimulation of IgG may increase inflammatory reaction thus may increase penetrability for the antigen which may jeopardize gingival protection against plaque antigen.

The peri oral approach is safe however the secretary immune response lasts for a short time.

Vaccination is a cheap method for protection against dental caries

