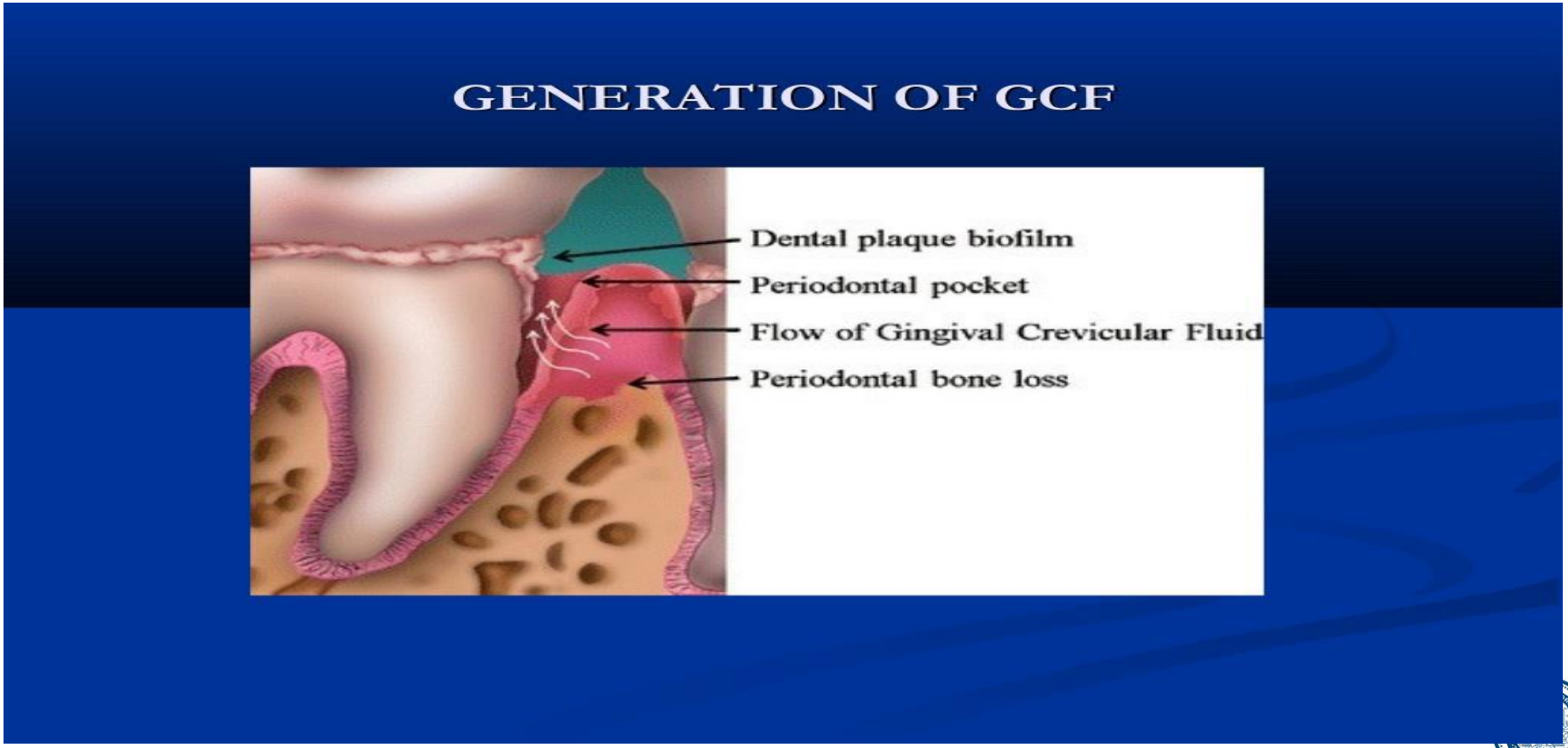
Defense Mechanism Of Oral Cavity



•The oral cavity is loaded with normal commensal microorganisms, aerobes and anaerobes. These organisms becomes pathogenic if the host defense is compromised.

•Hence an effective defense mechanism is necessary to safeguard the oral cavity from these attacks.

Defense mechanisms of oral cavity can be broadly classified into:

•Saliva
•Sulcular fluid
•Epithelial keratinocytes

Saliva:

The major salivary glands are:

•Parotid, sublingual and submandibular glands,

there basic functional units are cluster of cells called an acini.

•**The composition of saliva:**

•Water-99% or more and the other 1% include:

•Antibacterial factors

•Salivary antibodies

•Enzymes

•Salivary buffers and coagulation factors

Functions of saliva:

- It provide protection by its continuous flow and lubrication
- Buffering action: regulate pH via phosphate and bicarbonate
- Digestion: digest starch and lipids by amylases and lipases
- Facilitation of taste
- Defensive action against microbes: through antibodies, lysozymes, lactoferrin and secretary IgA.
- Ionic exchange between tooth surface

Antibacterial Factors in Saliva:

It contains numerous inorganic and organic factors that influence bacteria and their products in the oral environment.

Inorganic factors include: bicarbonate, sodium, potassium, phosphates, calcium, fluoride….

Organic components include:

- Lysozymes
- Lactoferrin
- Myeloperoxidase
- Lactoperoxidase
- Agglutinins(glycoprotein, mucins, fibronectin)

Lysozymes: a hydrolytic enzymes that cleaves the linkage between structural components of the cell wall of certain bacteria (both gram-negative and –positive) leading to cell lysis, its targets include Veilonella spp.and Actinobacillus.

•**Lactoferrin:** it binds the free iron in saliva causing bactericidal or bacteriostatic effects on various organisms requiring iron for their survival.
•It also provides fungicidal, antiviral, anti-inflammatory and immunomodulatory functions

Peroxidases:

•**The Lactoperoxidase - thiocyanate** system in saliva is bactericidal to some strains of Lactobacillus and Streptococcus by preventing the accumilation of lysine and glutamic acids essential for bacterial growth, also it is effective against Actinobacillus speceis.

•**Myeloperoxidase:** an enzyme similar to salivary peroxidase. It is released by leukocytesand is bactericidal for Actinobacillus.

Statherins:

inhibit the spontaneous precipitation of calcium phosphate salts and the growth of hydroxyapatite crystals on the tooth surface, preventing the formation of salivary and dental calculus.

- **The histatins:**

a family of histidine-rich peptides have antimicrobial activity against some strains of *Streptococcus mutans* and inhibit hemoagglutination of the periodontopathogen P. gingivalis

- Neutralize lipopolysaccarides of G-ve bacteria.
- Potent inhibitors of *Candida albicans*

Salivary Antibodies

•Salivary immunoglobulins include **sIg A** which is important defense substance in saliva, it inhibits bacterial adherence

•in addition to small amounts of **IgM and IgG**

•**Enzymes**

•The major enzyme is **parotid amylase.**

•Binds to bacteria promotes adhesion lead to either surface immune exclusion or adhesion of cariogenic or periodontopathogenic bacteria.

•**Proteolyticenzymes** in saliva are generated by both the host and oral bacteria and has been recognized as contributors to the initiation & progression of periodontal diseases.

❖ To combat with these enzymes, saliva contains antiproteases that inhibit cystein proteases as cathepsins and antileukoproteases that inhibit elastase.

Salivary Buffers & Coagulation factors:

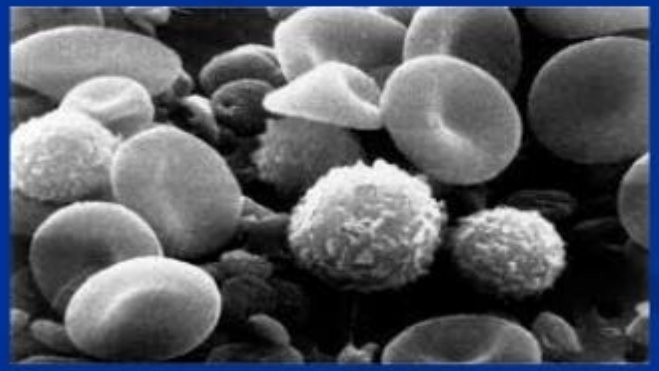
•**The most important buffer is bicarbonate-carbonic acid system:** which maintain the physiologic hydrogen ion concentration(pH) at the mucosal epithelial cells and the tooth surfaces

•**The coagulation factors include:** plasma thromboplastin antecedent (PTA); Hageman factor which hasten blood coagulation and protect wounds from bacterial invasion.

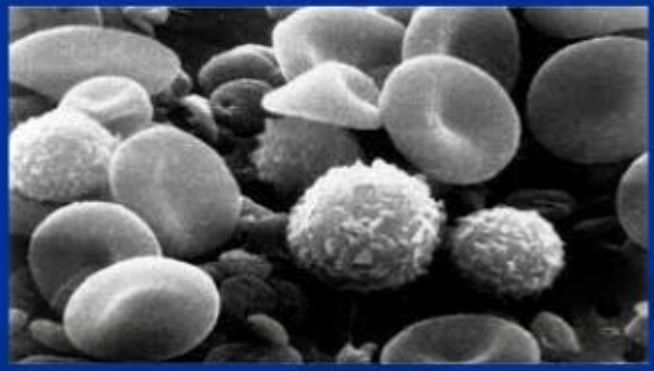
•An active fibrinolytic enzyme may also be present

LEUKOCYTES

- In addition to desquamated epithelial cells, the saliva contains all forms of leukocytes of which the principal cells are PMNs.
- The number of PMNs varies from person to person at different times of the day and is increased in gingivitis.



- PMNs reach the oral cavity by migrating through the lining of the gingival sulcus.
- Living PMNs in saliva are sometimes called **orogranulocytes**, and their rate of migration into the oral cavity is termed the **orogranulocytic migratory rate.**



2.SULCULAR FLUID

- Sulcular fluid or gingival crevicular fluid (GCF) is serum exudate secreted by sulcular epithelium in the gingival sulcus.

- The presence of this fluid has been known since the 19th century, but its composition and possible role in oral defense mechanism was elucidated by the pioneering work of *Waerhaug* and *Brill* and *Krasse* in the 1950s.

COMPOSITION OF GCF

- Cellular elements
- Electrolytes
- Organic compounds
- Metabolic and bacterial products
- Enzymes and enzyme inhibitors

Cellular elements

bacteria

desquamated epithelial cells

leukocytes (PMNs, lymphocytes, monocytes /macrophages)

Electrolytes

Potassium

sodium

calcium

METABOLIC & BACTERIAL PRODUCTS

- Lactic acid
- Hydroxy proline
- Prostaglandins
- Urea
- Endotoxins
- Cytotoxic substances
- Antibacterial factors

CELLULAR & HUMORAL ACTIVITY IN GCF

- Analysis of GCF has identified cell and humoral responses in both healthy and those with periodontal diseases
- The cellular immune response include the appearance of cytokines in GCF, but there is no clear evidence of a relationship between cytokines and disease.

- However, interleukin-1 alpha and IL-1 beta are known to increase the binding of PMNs and monocytes to endothelial cells, stimulate the production of prostagladinE_2 and release of lysosomal enzymes & stimulate bone resorption.

- Interferon alpha present in GCF have a protective role in periodontal disease because of its ability to inhibit bone resorption activity of IL-1 beta.

- Differential counts of leukocytes from clinically healthy gingival sulci have shown 91.2-91.5% PMNs and 8.5-8.8% mononuclear cells.

- Mononuclear cells were identified as 58% B lymphocytes, 24% T lymphocytes & 18% mononuclear phagocytes.

- The ratio of T lymphocytes to B lymphocytes was found to be reversed from normal ratio
- 1:3 in GCF

CLINICAL SIGNIFICANCE

- GCF is an inflammatory exudate.
- The amount of GCF is greater when inflammation is present.
- Factors which influence the amount of GCF are
  - Circadian periodicity
  - Sex hormones
  - mechanical stimulation
  - Smoking
  - Periodontal therapy

4-Epithelial cells :

They plays an important role in innate host defense by responding to bacterial infections.
This epithelium protect the deep structures and allow a selective interchange with the oral environment by its proliferation and differentiation.
The principle cell type of gingival epith. is the keratinocytes
The role of their defense is by the degree of keratinization
Other cells are nonkeratinocytes which include the langerhans cells, merkel cells and melanocytes

- Epithelial cells stimulated with bacterial components and cytokines directly produce MMPs, which contribute to loss of connective tissue.

- Epithelial cells also secrete a range of cytokines in response to periodontal bacteria (*P.gingivalis, A.actinomycetemcomitans, F.nucleatum, P.intermedia*), which signal immune responses.

- cytokines IL-1beta, TNF-alpha & IL-6 ,which serve to signal neutrophils and monocytes migration from the vasculature into periodontal tissues.

There are several factors which may prevent penetration of the intact oral mucosa by microorganisms as protective barrier include:

- 1-Saliva
- 2-Keratin
- 3-Granular layer
- 4-Basement membrane
- 5-leukocytes
- 6-Antibody