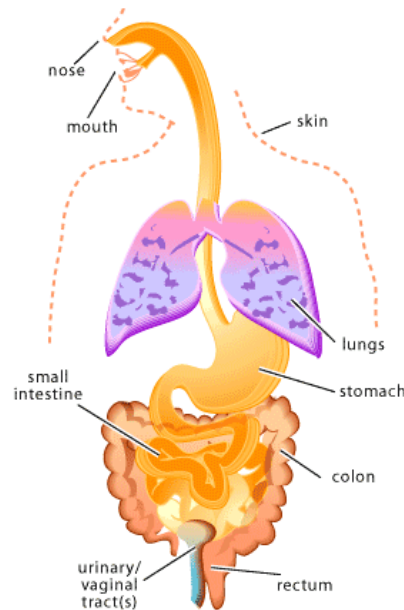


NORMAL FLORA OF HUMAN BODY



Introduction

In a healthy human, the internal tissues, e.g. blood, brain, muscle, etc., are normally free of microorganisms. However, the surface tissues, i.e., skin and mucous membranes, are constantly in contact with environmental organisms and become readily colonized by various microbial species. The mixture of organisms regularly found at any anatomical site is referred to as the normal flora. The normal flora of humans consists of a few eucaryotic fungi and protists, but bacteria are the most numerous and obvious microbial components of the normal flora. A healthy foetus in utero is free from microorganisms. During birth the infant is exposed to vaginal flora. Within a few hours of birth oral and nasopharyngeal flora develops and in a day or two resident flora of the lower intestine appears.

Normal Microbial Flora

The term “normal microbial flora” denotes the population of microorganisms that inhabit the skin and mucous membranes of healthy normal persons. The skin and mucous membranes always harbor a variety of microorganisms that can be arranged into two groups:

- 1.The resident flora consists of relatively fixed types of microorganisms regularly found in a given area at a given age; if disturbed, it promptly reestablishes itself.
- 2.The transient flora consists of nonpathogenic or potentially pathogenic microorganisms that inhabit the skin or mucous membranes for hours, days, or weeks; it is derived from the environment, does not produce disease, and does not establish itself permanently on the surface. Members of the transient flora are generally of little significance so long as the normal resident flora remains intact. However, if the resident flora is disturbed, transient microorganisms may colonize, proliferate, and produce disease.

RESIDENT FLORA

It consists of organisms which are regularly present in a particular area and when disturbed it reestablishes itself like *Esch.coli* is a normal inhabitant of the intestine.

Role of Resident flora

Microorganisms that are constantly present on body surfaces are commensals. Their growth in a given area depends upon physiologic factors like temperature, moisture, and the presence of certain nutrients and inhibitory substances. Resident flora of certain areas plays a definite role in maintaining health and normal function. Members of the resident flora in the intestinal tract synthesize vitamin K and aid in the absorption of nutrients. On mucous membranes and skin, the resident flora may prevent colonization by pathogens and possible disease through “bacterial interference.” The mechanism of bacterial interference is not clear. It may involve competition for receptors or binding sites on host cells, competition for nutrients, mutual inhibition by metabolic or toxic products, mutual inhibition by antibiotic materials or bacteriocins, or other mechanisms. Suppression of the normal flora tends to be filled by

organisms from the environment or from other parts of the body and such organisms behave as opportunists and may become pathogens.

On the other hand, members of the normal flora may themselves produce disease under certain circumstances and if removed from the restrictions of that environment and introduced into the bloodstream or tissues, these organisms may become pathogenic. For example, streptococci of the viridans group are the most common resident organisms of the upper respiratory tract and if large numbers of them are introduced into the bloodstream (eg, following tooth extraction or tonsillectomy), they may settle on deformed or prosthetic heart valves and produce infective endocarditis. Small numbers occur transiently in the bloodstream with minor trauma (eg, dental scaling or vigorous brushing). Bacteroides species are the commonest resident bacteria, if introduced into the free peritoneal cavity or into pelvic tissues along with other bacteria as a result of trauma, they cause suppuration and bacteremia.

There are many other examples, but the important point is that microbes of the normal resident flora are harmless and may be beneficial in their normal location in the host and in the absence of coincident abnormalities. They may produce disease if introduced into foreign locations in large numbers and if predisposing factors are present.

It has both advantages as well as disadvantages.

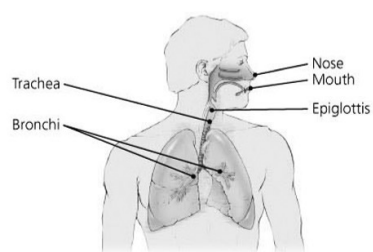
Advantages

- (i) They prevent or suppress the entry of the pathogens.
- (ii) These synthesize the vitamins especially Vit.-K and several B Group vitamins.
- (iii) The normal flora evokes the Antibodies production. These Antibodies cross react with pathogens having related or shared antigens, thus raising the immune status of the host against the invading pathogen.
- (iv) Colonies produced by some organisms of normal flora have a harmful effect on the pathogens.
- (v) Endotoxins liberated by normal flora may help the defense mechanism of the body.

Disadvantages

- (i) They become pathogenic when the immunity is lowered.
- (ii) They may act as pathogens in different issue (other than their normal habitat) e.g. normal flora of intestine may cause urinary tract infection (UTI).
- (iii) Normal flora may cause confusion in diagnosis due to their ubiquitous presence in the body and their resemblance to some of the pathogens.

SOME RESIDENT MICROBIOTA



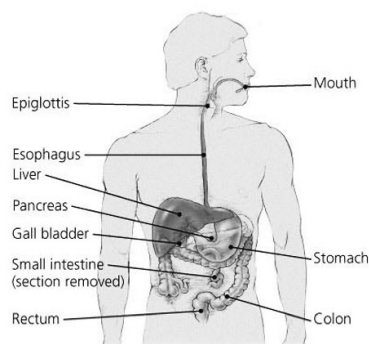
Upper Respiratory Tract

Genera

Fusobacterium, *Haemophilus*, *Lactobacillus*, *Moraxella*, *Staphylococcus*, *Streptococcus*, *Veillonella*, *Candida* (fungus)

Notes

The nose is cooler than the rest of the respiratory system and has some unique microbiota. The trachea and bronchi have a sparse microbiota compared to the nose and mouth. The alveoli of the lungs, which are too small to see at this magnification, have no natural microbiota.



Upper Digestive Tract

Genera

Actinomyces, *Bacteroides*, *Corynebacterium*, *Haemophilus*, *Lactobacillus*, *Neisseria*, *Staphylococcus*, *Treponema*, *Entamoeba* (protozoan), *Trichomonas* (protozoan)

Notes

Microbes colonize surfaces of teeth, gingiva, lining of cheeks, and pharynx, and are found in saliva in large numbers. Dozens of species have never been identified.

Lower Digestive Tract

Genera

Bacteroides, *Bifidobacterium*, *Clostridium*, *Enterococcus*, *Escherichia*, *Fusobacterium*, *Lactobacillus*, *Proteus*, *Shigella*, *Candida* (fungus), *Entamoeba* (protozoan), *Trichomonas* (protozoan)

Notes

Bacteria are mostly strict anaerobes, though some facultative anaerobes are also resident.

^aGenera are bacteria unless noted.

TRANSIENT FLORA

It consists of both non-pathogenic and potentially pathogenic bacteria that inhabit the body surface or mucous membranes for a limited period. They can be removed from the body surface by mechanical means like *Pneumococcus* and *Meningococcus* can be removed from nasopharynx of the human beings from time to time. Members of the normal flora form part of the host and include: saprophytes, commensals, facultative pathogens and true pathogens.

Normal Flora of the Skin

Skin is constantly exposed to and is in contact with the environment, the skin is particularly apt to contain transient microorganisms. The predominant resident microorganisms of the skin are aerobic and

anaerobic diphtheroid bacilli (eg, corynebacterium, propionibacterium); nonhemolytic aerobic and anaerobic staphylococci (*Staphylococcus epidermidis*, occasionally *S aureus*, and peptostreptococcus species); gram-positive, aerobic, spore-forming bacilli that are ubiquitous in air, water, and soil; alphahemolytic streptococci (viridans streptococci) and enterococci (enterococcus species); and gram-negative coliform bacilli and acinetobacter.

Low pH, fatty acids in sebaceous secretions and presence of lysozymes are important factors for eliminating non-resident microorganisms from the skin. Normal skin inhabits 10^2 - 10^4 organisms/sq. cm. Microorganisms present on the skin surface are *Staph.epidermidis* and Diphtheroids are the most common. Less common are Peptococcus, *Strept.viridens*, *Enterococcus*, *Micrococcus*, *Esch.coli*, *Candida*, etc.

Normal flora of Conjunctiva

The conjunctiva is relatively free from bacteria due to the presence of lysozyme in the tears which flushes the bacteria. Predominant organisms of the eyes are:

Moraxella sp Diphtheroids Straph epidermidis Moraxella sp
Non hemolytic streptococci

Normal Flora of Nose and Nasopharynx

The nasopharynx of the infant is sterile at birth but in 2-3 days time it acquires the flora carried by the mother and attendants. The nasopharynx is a natural habitat of the common pathogenic bacteria causing infection of the nose, throat, bronchi and lungs.

The flora of nose harbours Diptheroids Straphylococcus Streptococcus Haemophilus, and Moraxella lacunata

Normal Flora of the Mouth

The mouth contains micrococci, gram positive aerobic spore bearing bacilli, coliforms, proteus and lactobacilli. The gums pockets between the teeth and crypts of the tonsils have a wide spectrum of anaerobic flora like fusiform bacilli, treponemes, lactobacilli, etc. Candida is also found. The mouth of infant is not sterile at birth. It generally contains the same types of organisms as found in mother's vagina. These bacteria diminish in number and are replaced by similar bacteria present in the mouth of mother and nurse.

Normal Flora of Upper Respiratory Tract

Within 12 hours of birth alpha hemolytic streptococci are found in upper respiratory tract and become the dominant organism of the oropharynx and remains so for the whole life. In the pharynx and trachea, similar flora is established. Smaller bronchi and alveoli are normally sterile.

Normal Flora of Gastrointestinal Tract:

The GI Tract of the foetus in utero is sterile. It becomes contaminated with organisms shortly after birth. In breast fed infants, the intestine contains lactobacilli, enterococci, colon bacilli and staphylococci.

In bottle fed infants the intestine contains anaerobic lactobacilli, colon bacilli and aerobic and anaerobic spore bearing organisms. With the change of food, flora changes. Diet has a marked influence on the composition of the intestinal and fecal flora.

In the stomach as pH is low, the stomach is sterile but as the pH increases in small intestine the number of bacteria increases progressively beyond the duodenum to the colon. The bacterial count is low in small intestine as compared to large intestine. Lactobacilli and enterococci predominate in the duodenum and proximal ileum. The bacterial flora is similar in lower ileum, caecum and rectum. The anaerobic condition of colon is maintained by aerobic bacteria which utilizes the free oxygen.

Normal Flora of the Genitourinary Tract

Mycobacterium smegmatis a harmless commensal is found in the secretions (smegma) of both males and females genitalia. They may pose the confusion with the tubercle bacilli.

Strains of mycoplasma and ureaplasma are frequently present as part of normal flora. *Gardnerella vaginalis*, *bacteroides* and alpha streptococci have been found in penile urethra.

Female urethra is either sterile or contains *staphylococcus epidermidis*. The vagina of newly borne child is sterile and within 24 hours it colonizes with micrococci, enterococci. In 2-3 days time *Doderlien's* bacillus appears. So the flora keeps on changing depending upon the pH of the vagina. *Doderlien* bacilli remain in the vagina till menopause. After menopause flora resembles that before puberty.

WHAT HAVE YOU LEARNT

- Organisms found at any anatomical site is referred as normal flora
- A healthy fetus in utero is free from microorganisms and during birth the infant is exposed to vaginal flora.
- Normal microbial flora denotes the population of microorganism that inhabit the skin and mucous membranes of healthy normal persons.
- The microorganisms can be arranged into two groups namely resident flora and transient flora.
- Resident flora are fixed types of microorganism regularly found in a given area at a given age
- Transient flora consists of nonpathogenic or potentially pathogenic microorganisms that inhabit the skin or mucous membrane
- When the resident flora is disturbed, transient microorganism may colonize, proliferate, and produce disease
- Microorganisms that are constantly present on body surfaces are commensals. Their growth in a given area depends upon physiologic factors like temperature, moisture and the presence of certain nutrients and inhibitory substances.
- Resident flora of certain areas plays a definite role in maintaining health and normal function
- Resident flora is believed to prevent colonization by pathogens and possible disease through bacterial interference.
- Members of normal flora may themselves produce disease under certain circumstances and if removed from the restrictions of that environment and introduced into the bloodstream or tissues, these organisms may become pathogenic.
- Resident flora prevents or suppresses the entry of the pathogens.
- They synthesize the vitamins especially vitamin K and several B group vitamins
- Normal flora evokes the antibodies production and colonies of some organisms of normal flora have a harmful effect on the pathogens.
- Endotoxins liberated by normal flora may help the defence mechanism of the body.
- Low pH, fatty acids in sebaceous secretions and presence of lysozymes are important factors for eliminating non-resident microorganism from the skin.