Normal Flora

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Objectives

1. Define the terms: *Normal Flora, Resident flora, Transient flora* and carrier state
2. Know the origin of normal flora.
3. Know the effects and importance of normal flora eg.:
   A. Source of opportunistic infection.
   B. Immunostimulation.
   C. Nutrition: Vitamins production.
   D. Production of Carcinogens.
   E. Protection against external invaders.

Objectives, cont,.

4. Know areas of the body with normal flora (gastrointestinal tract, urogenital tract, and skin) , most common types of organisms and its relation to pathogenicity.
5. Know the sites of the body with no normal flora eg. sterile body sites and the importance of this fact in relation to interpretation of culture results.

Introduction

- **Normal flora** are population of **microorganisms** that are frequently found in the skin , mucous membrane and other particular sites in normal healthy individual.
- Some are found in association with humans and animals. The Majority are bacteria.
- Symbolic relationship (**symbiosis**): close association with the host.
- Subject to constant changes.
- Altered by antimicrobial agents.

Types of Normal Flora

- **Commensals:** Microorganisms that have natural relationship with the host. Found in low number and has no benefit or harm . Mainly associated with the GIT.
- **Residents** : Consist of relatively fixed types of microorganisms . Regularly found in a given area at invariable period. If disturbed promptly re-establish itself .

Types of Normal Flora-cont.

- **Transients** : Consist of **nonpathogenic** or **potential pathogenic** microorganisms that inhabit the skin or mucous membrane for hours or days.
- Transient organisms living in the external environment are attracted to moist and warm body sites.
- Excluded by host defense or competition from resident flora.

Transient flora- cont.,

Exist temporarily for the following reasons:

- They are washed by hand wash or bathing
- Competition by resident flora
- Killed by substances produced by resident flora
- May not survive in acidic or alkaline PH of the body site
- May be flushed away by body secretions like tears, sweat, oil urine and feces.

- **Carrier state:**

Potentially pathogenic bacteria that are carried by the individual without causing disease. However, it is the source of infection to other susceptible (non-immune) individual.

Examples: ***Neisseria meningitides*** and ***Streptococcus pneumoniae*** in the throat of healthy individual .

Origin of Normal Flora

- Newborn is sterile in uterus.
- After birth , newborn exposed to the flora of mother's genital tract, skin, respiratory tract flora of individuals handling him and the organisms in the environment.

Symbiosis

Symbiosis	First symbiont	Second symbiont
Neutralism	No effect	No effect
Commensalism	No effect	Benefit
Mutualism	Benefit	Benefit
Parasitism	Benefit	Harmed

Beneficial Effects of Normal Flora

1- **Immunostimulation** (*antibody production*)

2- **Exclusionary effect** (*vacuum effect*) and protection from external invaders.

3- **Antagonize** other bacteria through the production of substances (toxin) that inhibit or kill non-indigenous bacteria.

4-**Production of essential nutrients** (Vitamin K & B) by some normal intestinal flora eg. *E.coli*

5-others (see diagram)

Facts About Normal Flora

- May be a **source of** **opportunistic infections** in patients with impaired defense mechanisms.
- Some may **cross react with normal tissue** components ,eg. antibodies to various ABO group arise because of cross reaction between intestinal flora and the antigens of A & B blood substances.

HARMFUL EFFECTS: OPPORTUNISTIC INFECTION

-- Local or generalized host defense mechanisms are compromised

-- flora reaches protected areas of body in sufficient numbers

-- E. coli → ascend urethra → caused UTI

-- Colon perforation → feces in peritoneal cavity (peritonitis)

-- Viridians strep → blood → cause bacteremia + physiologic trauma or injury → colonize previously damaged valves →causing bacterial endocarditis

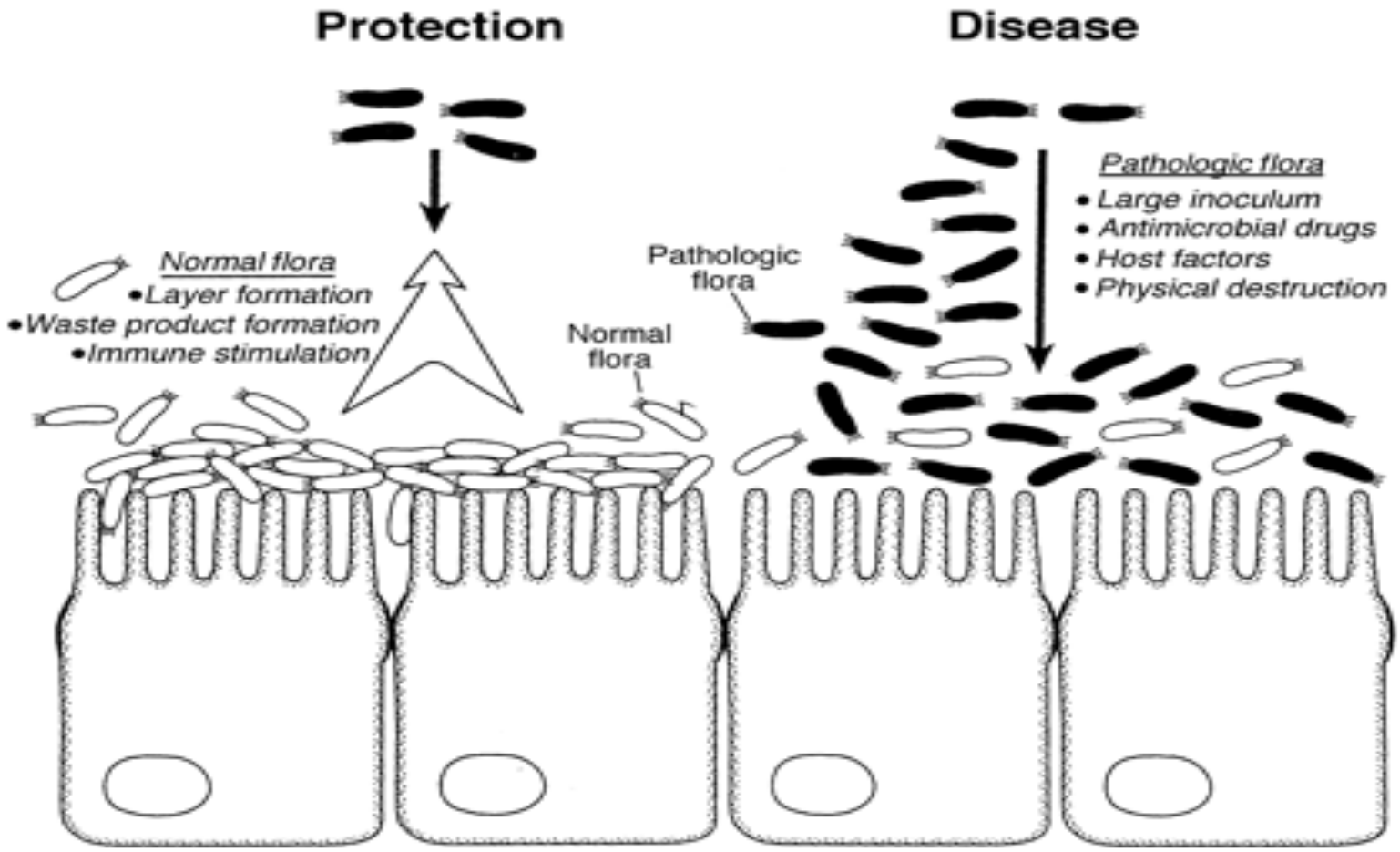
Facts About Normal Flora

- **Production of Carcinogens:**

  Some normal flora may modify through their enzymes chemicals in our diets into carcinogens. eg. artificial sweeteners may be enzymatically modified into bladder carcinogens.

- **Normal flora affected by :** antibiotics, tissue damage, mechanical procedures and diet change.

Normal Flora *vs* Pathogenic Flora



Distribution of Normal Flora

- **Normal flora found on external body sites**
- **Internal organs are sterile at health (*except the gastrointestinal tract*) .**
- **Sterility of internal organs maintained by :**

~ Local defense mechanisms

~ Chemical substances in serum & tissues eg. complement and antibodies.

~Phagocytic activity of Polymorphonuclear monocytes.

Sites	Load /gm	*Staphylococcus* aurous (Coagulase +)	Other Staph(Coagulase -) *Staphylococcus* epidermidis	Alph Hemolytic Streptococci (*Streptococci viridians and strept pneumo*	*Enterococcus*	*Neisseria ,Moraxella and Heaomophilus*	*Corynebacteria (diphtheroid)*	*Popionibacterium acnes Lactobacillus*	Gram Negative Bacteria (coliform ie E.coli)	*Pseudomonas*	Anaerobic bacteria (Bactericides, fusobacterium and clostridium)	Candida
Oral Cavity/ Upper Respiratory	10^6	+		+++		+++					+++	
Skin			+++				+++	++				
Eye and eye			+++				+++					
Axilla, Groin and nose		+++	+++				+++					
Stomach	10^2							+				
Small intestines	10^6			++				++	++		++	
Colon	10^{11}			+++	+++			++	+++	+++	+++	++
female Genital								+++				

Body sites with normal flora

All external body sites contain normal flora:

- Gastro intestinal tract : mouth & large colon
- Urogenital tract: vagina & distal one third of the urethra.
- Skin (including external ear & conjunctiva)

Normal flora of the respiratory tract

- Upper respiratory tract colonized by normal flora as in the mouth & nasopharynx
- Lower respiratory tract is sterile
- Common nose flora :

~ *Staphylococcus epidermidis*

~ *Staphylococcus aureus*

~*Corynebacterium species*

Normal flora of the oropharynx

- **Viridans streptococci**
- Commensal Neisseriae
- Corynebacteria
- Bacteroides
- Fusobacteria , Veillonella, Actinomyces, Spirochaetes.
- ***Heamophilus inflenzea & Pneumcoccus*** **are potential pathogens.**
- **Less common potential pathogens :** ***Streptococcus pyogenes and Neisseria meningitidis***

Normal flora of the GIT

- Saliva contains 10^8 bacteria/ml
- Gingival margin debris & dental Plaque continually colonized by bacteria.
- Oesophagus normal flora similar to pharyngeal flora.
- **Empty stomach sterile due to gastric acid.**
- **Duodenum, jejunum& upper ileium contain scanty flora**
- **Large intestine heavily colonized by bacteria.**

Feces (Stool)

- 1/3 of feces weight is bacteria , mainly dead.
- Living bacteria about 10^{10}/gm
- **99% anaerobes**
- Anaerobic environment maintained by aerobic bacteria utilizing free O2.
- ***Bacteroides fragilis*** group is the dominant anaerobes, Bifidobacteria , Lactobacilli…etc.
- **Less common aerobics: *E.coli*** ,*Proteus*,….etc.

Normal flora of the genital tract

- Female genital tract heavily colonized , why ?
- 10^8/ml flora in normal vaginal secretion.
- **In both sexes *Mycobacterium smegmatis* in secretions which contaminate urine and leads to confusion and misdiagnosis of tuberculosis.**
- Male & Female distal urethra:
  - *Staphylococcus epidermidis*
  - Corynebacteria
  - *Mycoplasma species*

Normal flora of the female Genital tract

- **Vulva** : *S. epidermidis , Corynebacteria, E.coli* and other coliforms & *Enterococcus faecalis*.
- **Vagina :**

~Lactobacillus (Doderlein's bacilli)

~ *Bacteroides melaninogenicus*

~*Enterococcus faecalis*

~ Corynebacteria

~*Mycoplasma*

~ Yeasts.

Normal Skin Flora

- Fatty acid , lysozymes by sweat gladns
- Skin has rich resident bacterial flora($10^4/cm^2$).
- Exist as microcolonies.
- Ano$_2$ organisms predominate in areas with sebaceous glands.
- Moist skin ,often colonized by coliforms.

Normal flora of skin

- Skin has rich resident bacterial flora($10^4/cm^2$).
- Exist as microcolonies.
- Anaerobic organisms predominate in areas with sebaceous glands.
- Moist skin often colonized by coliforms (Gram negative bacteria).

Skin Flora

Resident organisms

- In deeper layers of skin
- Permanent flora
- If disturbed reestablish themselves
- Not removed by routine hand wash
- Usually not associated with transmission of infection

Transient organisms

- In superficial layers of skin
- Temporary flora
- Usually do not reestablish themselves
- Easily removed by routine hand wash
- Usually associated with transmission of infection

Main skin flora:

- *Staphylococcus epidermidis*
- *Propionibacterium acnes*
- Anaerobic cocci
- Corynebacteria
- *Staphylococcus aureus* (potential pathogen)
- Coliforms

Normal flora of the external auditory meatus

External ear has the following normal flora:

- *S. epidermidis*
- Corynebacteria
- Acid fast bacilli (AFB) (occasionally in wax).

Middle and inner ear are sterile.

Normal flora of the eye

External auditory meatus

- *Staphylococcus epidermidis*
- *Corynebacteria*
- AFB occasionally in wax.

Conjunctiva and scalar flora

- *Staphylococcus epidrmidis*
- *Corynebacterium xerosis*

Reference book

- ***Sherris*** **medical microbiology** , an introduction to infectious diseases.

Kenneth Ryan/George Ray. Latest edition .
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