SURGICAL INFECTION

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OF M.S DEGREE IN GENERAL SURGERY

BY

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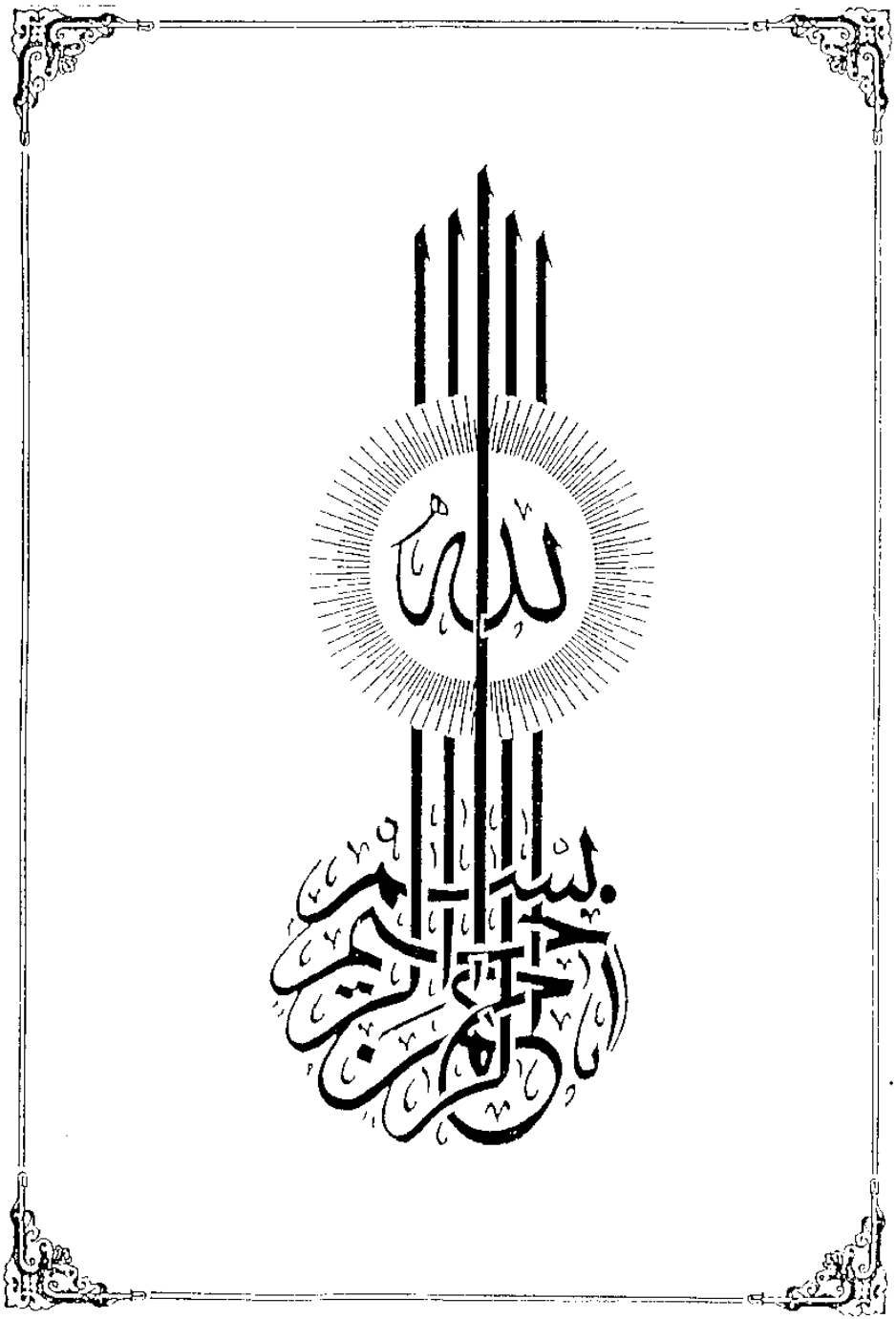

CONTENTS

Bacteriology of pyogenic wound infections

Infection is a dynamic process involving the invasion of the body by a pathogenic micro-organisms and reaction of the tissues to organisms and their toxins.

A surgical infection is an infection which requires surgical treatment and has developed before or as a complication of surgical treatment. Thus a post - operative wound infection is also a specific nosocomial (hospital - accquired) infection.

By definition, a wound is clinically infected if it contains 10^5 organisms per gram of tissue.

The micro-organisms commonly encountered in surgical infections are:

1- Staphylococci.
2- Streptococci
3- Gram negative intestinal bacilli
4- Pneumococci
5- Anaerobic organisms.

(1) Staphylococci

Morphology:

They are Gram positive spherical organisms 1um in diameter, arranged in grape like clusters. They are non sporing and non capsulated.

Cultural characteristics:

They grow easily on most media. They are aerobic and facultative anaerobes. They grow best at 37°C. On blood agar shiny convex colonies about 3mm in diameter appear within 24 hours, and these are pigmented. Most have a creamy white or dull yellow colour, but some species are golden or lemon yellow, though, pigmentation is no longer regarded as important, the organisms are still called staphylococcus albus when non pathogenic (whatever the actual colour of the colony) and staphyllococus aureus when pathogenic. Staph. aureus is sometimes called staph. Pyogenes, and staph albus is occasionally called staph. epidermidis. Staphylococci are divided into these two groups, according to the production of coagulase by the pathogenic group in the laboratory (Walter & Isreal, 1979)

Typing of staphylococci

They are typed with bacterio phage. The virulence and the type of the lesion produced, vary from one strains to another.The various phage types can be allocated to one of three group: Group I, contains many hospital epidemic strains. Group II, strains cause minor sepsis. Croup III, includes strains of animal origin, most of the enterotoxin-producing strains and many of the antibiotic-resistant hospital strains(Walter & Isreal 1979).

Toxin production

Staphylococcus is an invasive organism but the factors responsible for its virulence are not completely defined. Nevertheless, some toxins with endotoxin properties are known, they are :

- α toxin ; it produces local tissue necrosis, haemolysis and destroys leucocytes so it is a haemolysin and a leucocidin.
- Panton-valantine leucocidin; it destroys leucocytes only.
- Erythrogenic factor; has also described on a few occassions.

In addition three enzymes are produced :

- Coagulase: it is a precurs or of a substance like Thrombin which coagulate plasma even in the absence of calcium ion. It is produced by the pathogenic strains.
- Staphylokinase: it lyses fibrin by activating the plasmin system.
- Hyaluronidase: Both staphylokinase and hyaluronidase are produced by some strains but in small amounts.

- Some strains also produce an exotoxin called enterotoxin which is thermostable and produce symptoms of food poisoning when ingested.

Occurence:

The reservoir of pathogenic staphylococci is the anterior nares. About 40% of healthy adults are nasal carriers from the nares they are transferred to the skin particularly of the hands and perineum. (Walter & Isreal, 1979)

Staphylococcal albus is a universal commensal of the skin. It has become important as a cause of apportunistic, especially following surgery when foreign material is inserted.

(2) Streptococci

Morphology:

They are Gram - positive spherical organisms arranged in chains which vary in length, sometimes they are disposed in pairs. They are non motile, non sporing, non capsulate, but some trains possess very thin capsules called micro capsules. (Walter & Isreal 1979).

Cultural characteristics:

They are aerobes and facultative anaerobes. but few strains are obligatory anaerobes. They grow less easilly than staphylococci on ordinary media. On blood agar transparent colonies 0.5-1 mm in diameter develop surrounded by a zone of a variable degree of haemolysis. According to this degree of haemolysis the organisms are classified into three main groups. (Walter & isreal 1979).

1- ∝ haemlytic steptococci

They produce ill defined zone of haemolysis around their colonies on blood agar, they are also known as streptococcus viridans.

2- Bhaemolytic steptococci

They produce a sharp zone of complete haemolysis they sometimes called strept. haemolyticus.

3- Non - haemolytic streptococci

also called γ - type streptococci or strept-faecalis. Although both the first two varieties produce a haemolytic effect on blood agar, it is only the Bhaemolytic group that possesses a soluble haemolysin, capable of completely lysing horse red cell in suspension.

Lancefield grouping of streptococci:

B haemolytic streptococci were divided into 18 groups by Lance field according to the type of a carbohydrate hapten called the C antigen present in the wall of the organism, and detected by a precipitation test. The great majority of human pathogens fall into Lance - field's group A. and are known as streptococcus pyogenes (Walter & isreal 1979).

Toxin production

Streptococci are invasive organisms that produce powerful, toxic products they are:

1- streptolysin S : it is a pure haemolysin.

2- Streptolysin O : it is a haemolysin cardiotoxic and leucocidin.

3- Mprotein: it is a powerfully antigenic and it acts by interfering with phagocytosis.

4- Erythrogenic toxin : it is an exotoxin responsible for the punctate erythema seen in scarlet fever produced by some strains.

In addition the organisms produce the following enzymes:

. Streptokinase:

Which induces fibrinolysis by activating the plasmin system.

. Streptodornase:

it depolymerises D.N.A.

. Hyaluronidase:

Occurrence:

Streptococcus pyogenes is found in the throats of about 10% of normal individuals.(Walter & isreal 1979).

Other pathogenic streptococci

Group B (streptococcus agalactica) present in the female genital tract, Group C, and Group G B haemolytic streptococci are occassionally incrimenated in wound infections, streptococcus viridans which is an invariable commensal of the human mouth and throat sometimes causes wound infection.

Non haemolytic streptococci present in the colon are pathogenic when they leave their normal habitat.

Anaerobic streptococci which are normal inhabitants of the bowel and vagina are sometimes associated with wound infection. (Walter & isreal, 1979).

(3) Gram-negative intestinal Bacilli

Most of the members of this group belong to the family Enterobacteriaceae. The important pus forming genera are Eschericia, Klebsiella and Enterobacter (sometimes grouped together as Aerobacter) citrobacter, Hafnia and Proteus. Salmonella and Shigella are members of this group, but they are not pus froming organisms. Another important Gram - negative intestinal genus that causes suppuration is pseudomonas. It does not belong to the enterobacteriaceae, for although it may occur in the human intestine, this is not its natural habitat. It is widely distributed in nature. Of the pseudomonas species only one. Pseudomonas aeruginosa (commonly called Ps. pyocyanea) is pathogenic to man.

There are a number of proteus species, e.g. Pr. mirabilis, Pr. Vulgaris, Pr. morganii and Pr. rettgeri and they can be distinguished by biochemical reactions -El Batway 1982).

Morphology

They are all gram negative rods 1-4 u m long with a tendency to considerable variation in size. With a few conceptions, e.g. Klebsiella, they are vigourously motile. Klebsiella differs from the other in having a capsule. Non of these organisms forms spores.

(Walter & isreal 1979)

Cultural characteristic:

These organisms grew well at 37°C being aerobic and facultative anaerobic. On blood agar most members of this group produce greyish shiny colonies 3-5mm indiameter within 24 hours. Some proteus species are distinctive in spreading over the surface of the agar in a confluent layer and submerging other colonies that may be present. This called swarming. Pseudomonas aeruginosa produces bluish green pigmentation due to the formation of the pigments fluorescin and pyocyanin. These are best seen on nutrient agar. They also have a fresh odour resembling fruit.

Biochemical reactions

The most important ones are the sugar fermentation test. Nearly all ferment some sugars. But it is the fermentation of lactose which is most distinctive. E. Coli ferments lactose vigorously with the production of acid

and gas, and most of the related coliform group do like wise, but in some instances without gas formation. The distinctive property of lactose fermentation by some organisms is made use of in Mac Conkey's selective medium. The lactose in this medium is fermented by E. Coli and most coliform organisms and the lactic acid produced turns the natural red indicator a pink colour. There fore these colonies are pink, while those of salmonella, shigella, proteus and pseudomonas are colourless.

A) lactose fermenters	B) lactose non fermenters	c) late lacto fermente
coliform bacilli e.g. E. Coli, Klebsiella and citrobactor.	e.g. Salmonella, Shigella and proteus	e.g. Shigella sonnei, Vibrio

The main biochemical differences between E.Coli, Klebsiella and citrobacter.

	Indol	Methyl red	Vogos proskauer	Citrate
E. Coli	+	+	-	-
Klebsiella	-	-	+	+
citrobacter	-	+	-	+

+ : = acid and gas production
(-) negative =no production

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Occurrence

Unlike pyogenic streptococci and staphyllococci these organisms may be regarded as normal inhabitants of the body causing disease only when they leave their normal habitat. The role of gram negative bacilli as primary pathogens has long been known e.g. pseudomonas aeruginosa and salmonella typhi. Others have recorded only rarely as primary pathogens in human beings e.g. serratia marcescens and Enterobacter aerogenes (formerly Aerobacter aerogenes). However since the development of modern chemotherapy after world war II the gram negative bacilli have become increasingly important as cause of serious infection particularly in hospitalized patients.

Pseudomonas aeruginosa; is widely distributed and frequently present in small numbers on healthy skin surfaces and in the normal intestinal flora. As a pathogen it is often associated with pyogenic cocci or with enterobacteriaceae. It is incriminated in primary infections such as meningitis resulting from lumbar puncture, traumatic injuries to the eye and enteritis with associated bacteremia. Currently pseudomonas infection is the cause of death in patients having large burns, and it is common in post operative infections following the use of mechanical ventilators and indwelling urinary catheters.