Team 432 Microbiology

Identifying Uropathogens[1]

This document is a gathering of information we took in the previous blocks (and the renal block also) regarding the ways in which different bacteria are identified. It revolves around uropathogenes only. At the end of this document, you'll find several cases about urinary tract infections and their most common causative agents.

It should help you with the MCQ exam as well as the OSPE, because it revolves around the subjects covered in our theory lectures and practical sessions. This is student work and was not approved by a doctor. However, it was gathered from the lectures and the referenced book.

المهم في هذا الملف:

١) بالنسبة للبكتيريا الموجبة: المخطط في صفحة ٢ والجدول في صفحة ٤. ما بينهما مجرد شرح تفصيلي.

٢) بالنسبة للبكتيريا السالبة: الجدول في صفحة ٦.

Done by: Latifah Al-fahad

[1] pathogenic organisms in the urinary tract

First Step (general): Gram stain

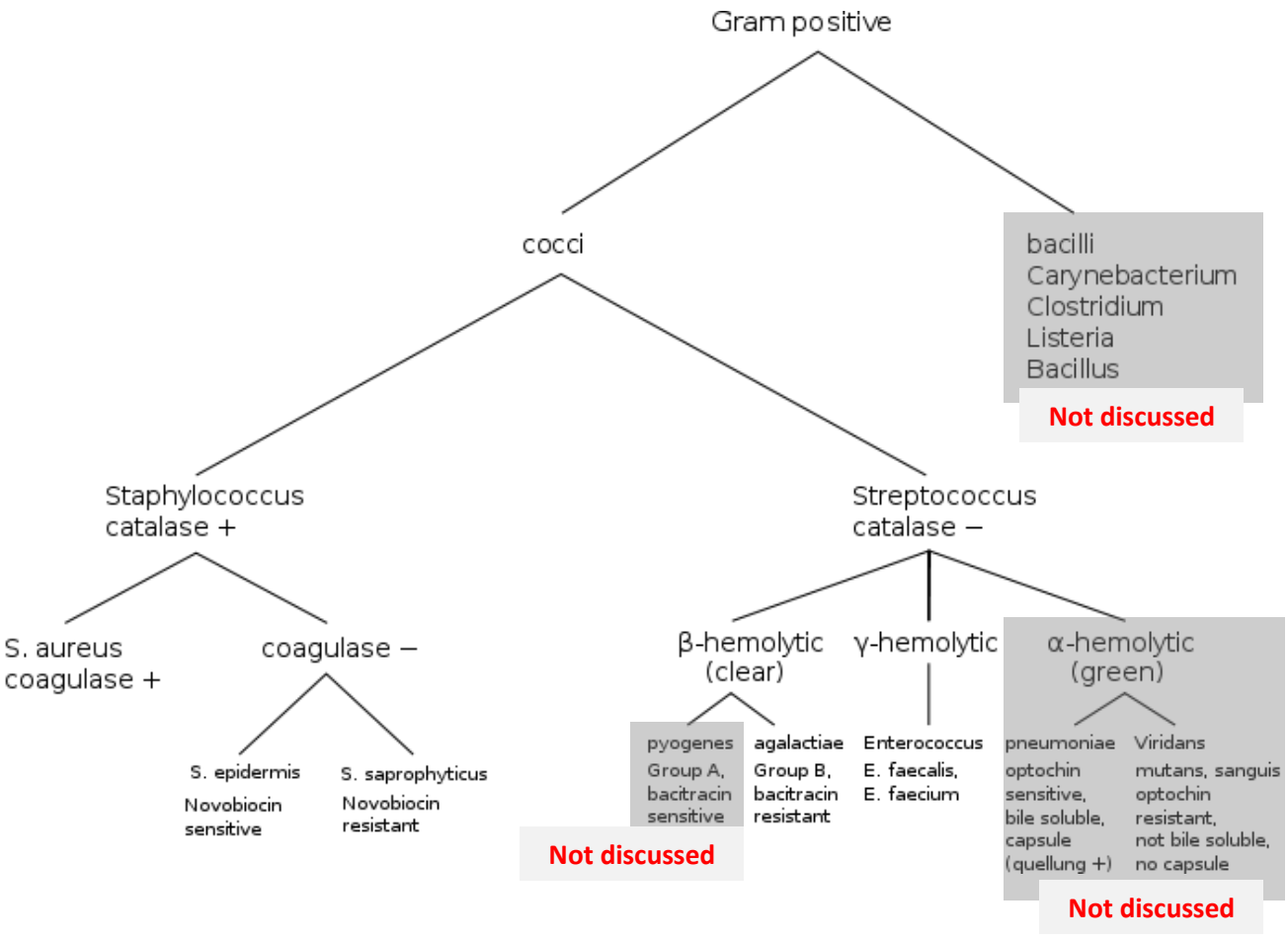
Whenever you come across bacterial infection, the first step it is to determine whether it's gram positive or negative bacteria.

Gram positive bacteria ➔ appear blue or purple

Gram negative bacteria ➔ appear unstained (usually pink to red)

Identifying different gram +ve bacteria:

After gram stain, if the bacteria appear to be positive, the second step is to identify their shape. I.e. Cocci (spherical in shape) or Bacilli (rod-shaped).



Second Step (gram +ve): Shape of bacteria

The shape is identified under the microscope. Gram +ve rods don't usually cause UTI, so they'll not be discussed. We will concentrate now on identifying different species of gram positive cocci.

Third Step (gram +ve cocci): arrangement of bacteria

Identifying the arrangement of the cocci is important. It can be done by looking at the slide under the microscope for the morphology of the arrangement, or by a simple catalase test. The gram +ve then will be either:

- Catalase positive ➔ staphylococci. (arranged as grape-like clusters)
- Catalase negative ➔ streptococci. (arranged as chains)

Catalase test: catalase is an enzyme that changes H_2O_2 to water and O_2. If the bacteria were catalase positive, it means that O_2 bubbles are seen.

Fourth step (gram +ve cocci): further identification

After knowing the arrangement of the bacteria, different tests will help you to identify further species. We will start first with staphylococci (catalase +ve bacteria) and then streptococci (catalase –ve bacteria).

1. Staphylococci:

There are 2 major groups that go under staphylococci, and we can differentiate between the two by simple coagulase test. The staphylococci then will be either:

- Coagulase positive ➔ e.g. Staphylococcus aureus.
- Coagulase negative ➔ e.g. S.epidermis OR S.saprophyticus.

Coagulase test: coagulase is an enzyme that converts fibrinogen to fibrin. If the bacteria were coagulase positive, fibrin threads are seen.

But what about coagulase negative bacteria? As we mentioned two examples, we should be able to differentiate between them. To know whether it's S.epidermis or S.saprophyticus, Novobiocin test is held.

- Novobiocin sensitive ➔ S.epidermis.
- Novobiocin resistant ➔ S.saprophyticus.

All three staphylococci are involved in UTI.

2. Streptococci:

There are 3 major groups that go under streptococci, and we can differentiate between them by hemolytic test. They could be either:

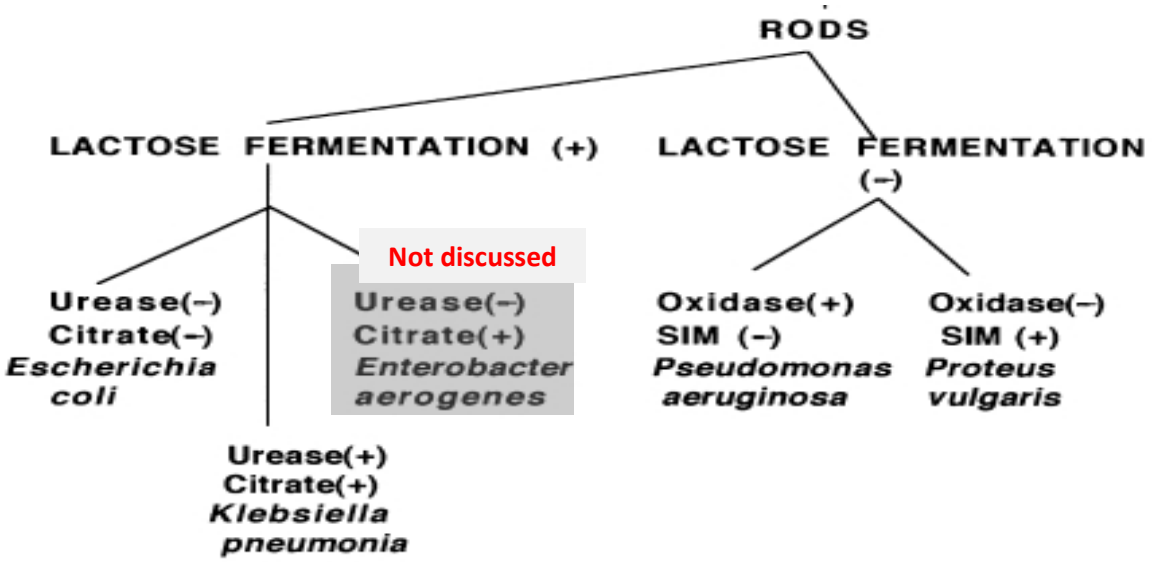
- **Beta hemolytic:** with 2 subdivisions: 1) Group A (doesn't cause UTI)
  2) **Group B (Causes UTI)**
- **Gamma hemolytic:** Called Enterococci. One example is **E. faecalis**.
- **Alpha hemolytic:** doesn't cause UTI.

Summary: Gram +ve cocci

bacteria	Catalase test	Further tests		Relation to UTI
S.aureus	positive	Coagulase positive		Rare cause of pyelonephritis
S.epidermis		Coagulase negative	Novobiocin sensitive	1.Rare cause of cystitis. 2.Rare cause of pyelonephritis.
S.saprophyticus			Novobiocin resistance	1.Causes honeymoon cyctitis 2.rare cause of pyelonephritis.
Group B strep.	Negative	Bacitracin resistance		Rare cause of cystitis.
E. faecalis		Esculin positive		1.Rare cause of cystitis. 2.cause of pyelonephritis.

Identifying different gram –ve bacteria:

After gram stain, if the bacteria appear to be negative, the second step is to identify its shape. I.e. Cocci (spherical in shape), Bacilli (rod-shaped) or coccobacilli. Gram –ve cocci and coccobacilli don't usually cause UTI. However, it could cause urethritis associated with sexual transmitted diseases. One example is Neisseria gonorrhoeae. For now, we will focus on gram –ve bacilli only.



Second Step (gram –ve bacilli): further identification

Gram negative bacilli are of 2 major types, either lactose fermenting or non-lactose fermenting. To determine the type, different media are used to culture the bacteria and detect lactose fermentation. For example, MacConkey's agar and CLED agar. Lactose fermenting bacilli will appear pink on MacConkey's and yellow on CLED, non-lactose fermenting, on the other hand, will appear colorless or will take the same color as the medium.

The bacilli then will be either:

- Lactose fermenting ➔ Escherichia coli or Klebsiella pneumonia
- Non-lactose fermenting ➔ Proteus vulgaris or Pseudomonas aeruginosa

After knowing which type the bacteria is, further identification is needed. Let's start first with lactose fermenting bacteria.

1. Lactose fermenting bacteria:

There are two major examples for lactose fermenting bacteria, E-coli and Klebsiella pneumonia. To differentiate between the two, Indole test is done.

- Indole positive ➔ E-coli
- Indole negative ➔ Klebsiella pneumonia

E-coli and Klebsiella are both oxidase negative.

2. Non-lactose fermenting bacteria:

There are two major examples for non-lactose fermenting bacteria, Proteus and P.aeruginosa. To differentiate between the two, oxidase test is done.

- Oxidase positive ➔ P.aeruginosa
- Oxidase negative ➔ Proteus

Proteus is also urease positive.

Urease test: urease is an enzyme that converts urea to ammonia.

Summary: Gram –ve bacilli

<table>
<tr><th>bacteria</th><th>Lactose fermentation</th><th colspan="2">Further tests</th><th>Relation to UTI</th></tr>
<tr><td>E-coli</td><td rowspan="2">positive</td><td rowspan="2">Oxidase negative</td><td>Indole positive</td><td>1.commenest cause of cystitis.
2.commonest cause of pyelonephritis.</td></tr>
<tr><td>Klebsiella</td><td>Indole negative</td><td>1.Rare cause of cystitis.
2.cause of pyelonephritis.</td></tr>
<tr><td>P.aeruginosa</td><td rowspan="2">Negative</td><td colspan="2">Oxidase positive</td><td>1.cause of cystitis.
2.cause of pyelonephritis.</td></tr>
<tr><td>Proteus</td><td>Oxidase negative</td><td>Urease positive</td><td>1.Rare cause of cystitis.
2.cause of pyelonephritis.</td></tr>
</table>

Fungi and parasites could also cause UTI but as they are rare causes, they are not discussed.

If you have any comments or if you detect any mistakes please contact us on the team's e-mail address: Microbiology432@gmail.com

Thank you and good luck!