

organism	Morphology	Culture characters	Biochemical activities	Diagnosis
<p><b>Escherichia coli</b></p> <ul style="list-style-type: none"> <li>- Normal inhabitants of the intestine of the man and animals,</li> <li>- some can cause disease in man</li> </ul>	<ul style="list-style-type: none"> <li>- Gram –ve bacilli,</li> <li>- motile,</li> <li>- some capsulated</li> </ul>	<p><b>- Facultative anaerobes.</b></p> <ul style="list-style-type: none"> <li>- <b>On macConkey agar:</b> they produce rose-pink colonies due to lactose fermentation.</li> <li>- <b>On Blood agar:</b> strains causing UTI produce hemolysis on blood agar.</li> <li>- <b>Simple media :</b> grow on simple media</li> <li>- <b>XLD and CLED agar:</b> Yellow colonies</li> </ul>	<ul style="list-style-type: none"> <li>- <b>They ferment:</b> <ul style="list-style-type: none"> <li>• Glucose</li> <li>• Maltose</li> <li>• Mannite</li> <li>• Sucrose</li> <li>• Salicin</li> </ul>           With production of acid and gas.         </li> <li><b>+ve to :</b> <ul style="list-style-type: none"> <li>• Indole</li> <li>• M.R.</li> </ul> </li> <li><b>-ve to :</b> <ul style="list-style-type: none"> <li>• Oxidase.</li> <li>• Urease</li> <li>• H2S.</li> <li>• P.V.</li> <li>• Citrate</li> </ul> </li> <li>- Can generate energy by reducing nitrates to nitrites.</li> </ul>	<ul style="list-style-type: none"> <li>- <b>The specimen is:</b> Urine, stool, pus ..etc</li> <li>- <b>They are cultured on macConkey medium :</b> resulting in(look previous) , and further identified by their morphology and biochemical reactions.</li> <li><b>In case of diarrhea :</b> Isolated E.Coli should be further tested serologically and virulence proved :           <ul style="list-style-type: none"> <li>• <b>Serotyping</b> by slide agglutination for EPEC and EHEC strains.</li> <li>• <b>When HEHC infection is suspected,</b></li> <li>• rapid diagnostic methods are used to detect the verotoxin by ELISA,</li> <li>• or to detect the organism by immunofluorescence in stools.</li> </ul> </li> <li>Vivo assays, tissue cultures , immunoassay, DNA probes, PCR maybe used for detection of toxin production or its ge</li> </ul>
<p><b>Klebsiella</b></p>	<ul style="list-style-type: none"> <li>- Gram -ve Bacilli</li> <li>- non-motile.</li> <li>- capsulated.</li> </ul>	<ul style="list-style-type: none"> <li>- <b>On macConkey agar:</b> they produce pink colonies due to lactose fermentation.</li> <li>- The colonies are mucoid due to the production of abundant extracellular slime.</li> </ul>	<ul style="list-style-type: none"> <li>- <b>They ferment:</b> <ul style="list-style-type: none"> <li>• Glucose</li> <li>• Sucrose</li> <li>• Salicin</li> <li>• Maltose</li> <li>• Mannite</li> </ul>           With production of acid and gas.         </li> <li><b>-ve to :</b> indole, M.R.</li> <li><b>+ve to:</b> V.P, Citrate</li> </ul>	<ul style="list-style-type: none"> <li>- <b>They are cultured on macConkey medium:</b> resulting in(look previous) , and further identified by their morphology and biochemical reactions.</li> <li>- <b>in smears from tissues stained by gram :</b> capsulated organisms can be seen</li> <li>- <b>It's highly pathogenic to the mice</b> and cause their death within 24-48 hours when injected intra</li> </ul>
<p><b>Proteus</b></p> <ul style="list-style-type: none"> <li>* Species are found in:           <ul style="list-style-type: none"> <li>• soil</li> <li>• water</li> </ul> </li> <li>* The genus includes two important species:           <ul style="list-style-type: none"> <li>• Pr.vulgaris</li> <li>• Pr.mirabilis</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>- Gram -ve Bacilli</li> <li>- Highly motile.</li> <li>- Very pleomorphic.</li> <li>-Non-capsulated</li> </ul>	<p><b>- Facultative anaerobes.</b></p> <ul style="list-style-type: none"> <li>- <b>On MacConkey agar:</b> they produce pale non-lactose fermenting colonies.</li> <li>- <b>On nutrient agar:</b> Due to their highly motility, they give colonies which swarm in successive waves over the surface on nutrient agar with "fishy odour"</li> </ul>	<ul style="list-style-type: none"> <li>- <b>They ferment:</b> <ul style="list-style-type: none"> <li>• Glucose</li> <li>• Sucrose</li> <li>• Salicin</li> </ul>           With production of acid and gas.         </li> <li><b>+ve to :</b></li> <li>- <b>phenylalanine deaminase.</b></li> <li>- <b>urease ,</b> <ul style="list-style-type: none"> <li>- which catalyzes the hydrolysis of urea to ammonia</li> <li>- differentiate them from salmonella &amp; shigella .</li> </ul> </li> <li>- <b>H2S</b> Which blackens the butt of triple sugar iron (TSI) agar.</li> <li>- <b>Indole</b></li> <li>- <b>MR</b></li> <li><b>-ve to:</b></li> <li>- <b>VP</b></li> <li>- <b>Citrate Variable</b></li> </ul>	<p>By:</p> <ul style="list-style-type: none"> <li>• Colony morphology.</li> <li>• Biochemical</li> </ul>

<p><b>Pseudomonas</b></p> <p>* Species are found in</p> <ul style="list-style-type: none"> <li>• soil</li> <li>• sewage</li> <li>• and water</li> </ul> <p>- some are commensals in the intestine.</p> <p>* The commonest human pathogen of this group is : Ps.aeruginosa</p>	<p>- <b>Gram -ve Bacilli</b></p> <p>- Motile.</p> <p>- some strains are encapsulated .</p> <p>- Non-sporing</p>	<p align="center"><b>- Aerobe.</b></p> <p><u>- On MacConkey agar:</u> they produce pale non-lactose fermenting colonies.</p> <p><u>- On Blood agar:</u> Haemolyze the blood.</p> <p><u>- On nutrient agar:</u> Grow on nutrient agar leading to greenish colouration of the medium due to its diffusible exopigment which consists of :</p> <ul style="list-style-type: none"> <li>- pyocyanin (blue)</li> <li>- pyoverdin or fluorescein (yellow- green fluorescent)</li> </ul> <p>- Cultures have a sweet grap-like odour -Metallic appearance.</p>	<p>- Ps. Aeruginosa is</p> <p align="center"><b>Oxidase +ve</b></p> <p>- Acid is produced from <b>glucose</b> by oxidation only.</p> <p align="center"><b>- Doesn't ferment any sugar.</b></p> <p><b>- ve to :</b></p> <p align="center">H2S VP MR</p>	<p><b>1-</b> P. aeruginosa can be isolated in:</p> <ul style="list-style-type: none"> <li>- (blood agar)</li> <li>- (MacConkey agar)</li> </ul> <p>Identification is based on the results of biochemical and other diagnostic tests</p> <ul style="list-style-type: none"> <li>- ( Nutrient agar )</li> </ul> <p><b>2-</b> Pus from the lesion maybe greenish blue.</p> <p><b>3-</b> Smears stained by gram show gram -ve bacilli among pus cells.</p>
<p><b>Candida Albicans</b></p> <p>- Is the most important species of Candida.</p> <p>It is part of the normal flora of the mucous membrane of the upper respiratory, gastrointestinal &amp; female genital tract.</p> <p>In these sites, it may predominate and cause super infection</p>	<p align="center"><b>gram +ve</b></p> <p>large oval budding yeast with pseudohyphae</p> <p><u>Direct microscopic examination</u>, of smear or exudates from the lesions shows the previous morphology.</p>	<p><u>Cultures</u> are done on:</p> <ul style="list-style-type: none"> <li>- nutrient agar,</li> <li>- corn meal agar</li> <li>- Sabouraud Dextrose Agar.</li> </ul> <p>Colonies are soft, cream-colored with a yeasty odour.</p> <p><u>Colonies are also identified by :</u></p> <ol style="list-style-type: none"> <li>1- <b>Morphology</b> ←</li> <li>2- Germ tube formation in serum</li> <li>3- Chlamyospore formation on corn meal agar</li> <li>4 <b>-Biochemical reactions</b> →</li> </ol>	<p><u>They ferment:</u></p> <p align="center">glucose maltose</p> <p align="center">with acid and gas production</p>	<p>By:</p> <ul style="list-style-type: none"> <li>• Colony morphology.</li> <li>• Culture characters.</li> <li>• Biochemical activities</li> </ul>
<p><b>Helicobacter pylori</b></p> <p>- <u>It Causes</u> chronic gastritis peptic and duodenal ulcer .</p> <p>- <u>It is a risk factor for gastric carcinoma</u> , linked to mucosa associated lymphoid tissue ( MALT ) &amp; iron deficiency anemia .</p>	<p><u>It's similar to campylobacters in morphology :</u></p> <p>small <b>gram -ve</b> rods with comma ,S, or "gullwing shapes".</p> <p><b>Motile like campylobacter BUT</b> different having multiple sheathed monopolar flagella <b>while</b> campylobacter have single unsheathed at one or both poles.</p>		<p align="center"><u>+ve to :</u></p> <p align="center"><b>- urease</b></p> <p>while campylobacter is urease -ve</p> <p align="center"><b>- oxidase</b></p> <p align="center"><b>- catalase</b></p>	<p><u>1- Gastric biopsy specimens :</u></p> <ul style="list-style-type: none"> <li>- Obtained b endoscopy are <b>minced</b> in saline and <b>cultured</b> as in campylobacter (they are microaerophilic ; grows best in presence of 5% oxygen and 10% co2) but incubated at 37c in a humid atmosphere for 7 days</li> <li>- Smears stained with <b>gram</b> and histologic sections stained with special stains, show the curved or spiral organisms.</li> </ul> <p><u>2- Rapid urease test :</u></p> <ul style="list-style-type: none"> <li>- in which gastric biopsy material is placed onto a medium containing urea with a colour indicator.</li> <li>- If H.pylori is present, the urease splits the urea and results in shift of the ph and leading to colour change.</li> </ul> <p><u>3-Non-invasive methods for the diagnosis include:</u></p> <ol style="list-style-type: none"> <li><b>Urea breath test:</b> A capsule of 14C -labeled urea is ingested by the patient. If the organism is present the urease activity generates radiolabelled CO2 that can be detected in patient's exhaled breath .</li> <li><b>Direct detection of H.pylori antigen</b> by ELISA in stools is a useful test for diagnosis &amp; follow up the results of treatment .</li> <li><b>PCR</b>, applied on gastric juice, faeces or biopsy specimens.</li> <li><b>Serologic detection</b> of H.pylori antibodies by ELISA: high titers are found in chronically infected patients.</li> </ol>

# Neisseriae

**Meningitis** is the most common complication of meningococcaemia.

Usually begins suddenly, with severe headache, fever, vomiting & rigidity of the neck & back of muscles .... It may progress to coma within few hours

Morphology	Culture characters	Biochemical activities
<ul style="list-style-type: none"> <li>- Gram Negative –ve diplococci arranged in pairs.</li> <li>- Kidney shaped appearance.</li> <li>- Occur intracellularly in <b>Pus cells &amp; Extracellularly.</b></li> </ul>	<p style="text-align: center;"><b>Aerobes</b></p> <ul style="list-style-type: none"> <li>- Enriched media for growth containing heated blood (e.g. Chocolate agar)</li> <li>- Selective Modified Thayer Martin (MTM) medium containing antibiotics that inhibit growth of other organisms . Colony is smooth, translucent, and non pigmented.</li> </ul> <p style="text-align: center;">Cultures incubated in a humid atmosphere containing 5-10% CO<sub>2</sub> at 35-37 C</p>	<ul style="list-style-type: none"> <li>- <b>Oxidase test :</b> All neisseria species give a +ve Oxidase Reaction (because they possess Enzyme cytochrome c) where a deep purple colour develops.</li> <li>- <b>Acid production from sugars:</b> <ul style="list-style-type: none"> <li>- Can be used to differentiate it from other species.</li> <li>- N. gonorrhoea → Glucose +ve only .</li> <li>- N. meningitidis → glucose &amp; maltose +ve .</li> </ul> </li> </ul>

<b>N. gonorrhoea</b>	<b>N. meningitidis</b>
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They cause gonorrhoea which is a sexually transmitted disease (STD)	<ul style="list-style-type: none"> <li>- <b>Meningitis</b> is the most common complication of meningococcaemia.</li> <li>- Usually begins suddenly, with severe headache, fever, vomiting &amp; rigidity of the neck &amp; back of muscles, It may progress to coma within few hours</li> </ul>
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Diagnosis	Diagnosis
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<ul style="list-style-type: none"> <li>• <b><u>In Acute male urethritis :</u></b> The urethral discharge is examined by direct smear stained by GRAM . the presence of gram –ve diplococci intracellularly and extracellularly in pus cells is diagnostic.</li> <li>• <b><u>In chronic male infection, acute and chronic female infection and when facing medicolegal problems as in sexual abuse :</u></b></li> </ul> <p><u>Specimens :</u> Discharge from urethra, cervix, rectum, conjunctiva, throat or synovial fluid. Examined by:</p> <ul style="list-style-type: none"> <li>• <b>Direct smears</b> stained by gram are usually difficult to interpret due to presence of the organism in small numbers mixed with normal flora</li> <li>• <b>Two rapid tests</b> are used to detect gonococcal nucleic acids in the patient's specimens .In one test the nucleic acid is not amplified and in the second test it is amplified .Latter can be used on urine samples obviating the need for more invasive collection techniques</li> <li>• <b>Cultures</b> are done on chocolate agar or MTM medium incubated at 35-37C in a humid atmosphere in 5-10%CO<sub>2</sub>. Suspected colonies are identified by Morphology,Bio. Activity (Oxidase +ve and acid production from glucose only) ,or serologically by fluorescent antibody staining or coagglutination tests ,using specific antisera.</li> <li>• <b>Blood cultures</b> may be needed for diagnosis of DGI (disseminated gonococcal infections)</li> </ul>	<ol style="list-style-type: none"> <li>1. <b>The CSF</b> by lumbar puncture,under complete aseptic conditions , <b>On physical examination</b> → In meningitis ,The CSF is under tension and turbid due to large number of pus cells ( 20 000/cmm ) . <b>On chemical examination</b> → the proteins are elevated ↑ ... Glucose is reduced ↓             <ol style="list-style-type: none"> <li>a) CSF is centrifuged ,Deposit is examined Microscopically after staining with <b>GRAM</b>. The presence of gram –ve diplococci in pus cells intracellularly is diagnostic</li> <li>b) Detection of MENINGOCOCCAL POLYSACCHARIDE ANTIGENS in CSF by Coagglutination test Latex agglutination kits for detection of antigens in CSF. ( useful for rapid diagnosis)</li> <li>c) The deposits is cultured on Chocolate agar and incubated at 35-37 C in a humid atmosphere containing 5-10% CO<sub>2</sub>...colonies appear in 2-3 days ,identified by:                 <ul style="list-style-type: none"> <li>• <b>Morphology</b> → gram –ve diplococci</li> <li>• <b>Biochemical reactions</b> → Oxidase production ,Acid production from maltose &amp; glucose</li> <li>• <b>Agglutination with anti-meningococcal serum</b></li> <li>• <b>Fluorescent antibody staining may be use for identification</b></li> </ul> </li> </ol> </li> <li>2) <b>Blood cultures</b> : commonly give +ve results</li> <li>3) <b>PCR test</b> : detect meningococcal DNA in Blood and CSF</li> </ol>
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NB: Other STDs e.g.syphilis,non-gonococcal urethritis caused by Chlamydia & HIV can coexist with gonorrhoea

**NB. For Diagnosis of meningococcal Carrier:**

- 1- Nasopharyngeal swabs are cultured on Enriched media (MTM) ;
- 2- isolated gram –ve diplococci should be differentiated from commensal neisseria by the difference in cultural character, biochemical reactions & SEROLOGIC identification with specific antimeningococcal serum

