Neisseria spp.

The genus Neisseria consists of gram-negative, aerobic cocci.

Two Neisseria species are pathogenic for humans
Neisseria gonorrhoeae (commonly called gonococcus), the causal agent of gonorrhea and Neisseria meningitidis (commonly called meningococcus), a frequent cause of meningitis.

Gonococci and meningococci are nonmotile diplococcic that cannot be distinguished from each other under the microscope but can be differentiated in the laboratory by sugar-use patterns, and the sites of their primary infections.

Both bacteria are classified as **pyogenic cocci** because infections by these organisms are also characterized by the production of purulent (puslike) material comprised largely of white blood cells.

N. gonorrhoeae: gonococci (GC)

Structure

Gonococci are **unencapsulated** (unlike meningococci), piliated, and nonmotile, and they resemble a pair of kidney beans.

1. **Pili**
2. **Lipooligosaccharide**
3. **Porin proteins**
4. **Opacity proteins**

Pathogenesis

Pili and Opa proteins facilitate adhesion of the gonococcus to epithelial cells of the urethra, rectum, cervix, pharynx, and conjunctiva, thereby making colonization possible. There, the organisms may cause a localized infection with the production of pus or may lead to tissue invasion, chronic inflammation, and fibrosis.

In addition, both gonococci and meningococci produce an **IgA protease** that cleaves IgA1, helping the pathogen to evade immunoglobulins of this subclass.

The gonococcus requires iron for growth and survival in vivo.

A higher proportion of females than males are generally asymptomatic, and these individuals act as the reservoir for maintaining and transmitting gonococcal infections.

1. **Genitourinary tract infections:** Symptoms are more acute and easier to diagnose in males. The patient typically presents with a yellow, purulent urethral discharge and painful urination. In females, infection occurs in the endocervix and extends to the urethra and vagina. A greenish-yellow cervical discharge is most common. The disease may progress to the uterus, causing salpingitis (inflammation of the fallopian tubes), pelvic inflammatory disease (PID), and fibrosis. Infertility occurs in approximately 20 percent of women with gonococcal salpingitis.
2. **Rectal infections**
3. **Pharyngitis**
4. **Ophthalmia neonatorum**: This infection of the conjunctival sac is acquired by newborns during passage through the birth canals of infected mothers. If untreated, acute conjunctivitis may lead to blindness.
5. **Disseminated infection:** Most strains of gonococci have a limited ability to multiply in the bloodstream. Therefore, bacteremia with gonococci is rare. In contrast, meningococci multiply rapidly in blood.

LABORATORY FEATURES

Specimens: Urethral and cervical exudate, urine (centrifuged) from male patients, and a rectal swab. An eye swab is required when gonococcal conjunctivitis of the newborn is suspected.

Morphology

Gram negative diplococcus, typically seen in pus cells (intracellular) but also extracellularly.

Making smears: To avoid damaging pus cells, a swab should be gently rolled on a slide when making a smear and the preparation, methanol-fixed rather than heat-fixed.

Culture

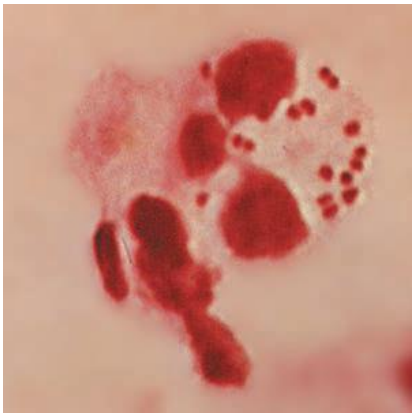
N. gonorrhoeae is an aerobe or facultative anaerobe. It is a fastidious organism which requires culturing with the minimum of delay.

An **enriched selective medium such as modified New York City (MNYC)** medium or **Thayer Martin** medium is required to isolate *N. gonorrhoeae* from urogenital specimens.

Gonococci grow best in a moist carbon-dioxide enriched atmosphere. Optimum temperature for growth is 35–36 ºC.

***MNYC medium and Thayer Martin medium*:** *N. gonorrhoeae* grows rapidly producing small, raised, grey or translucent colonies after overnight CO2 incubation.
Examine a Gram stained smear of the colonies and perform an oxidase test (positive).
Biochemical test

- Ferments glucose but not maltose, sucrose, or lactose
- DNA-ase negative
- *Beta*-galactosidase (ONPG) negative
- Glutamyl-aminopeptidase (GAP), negative



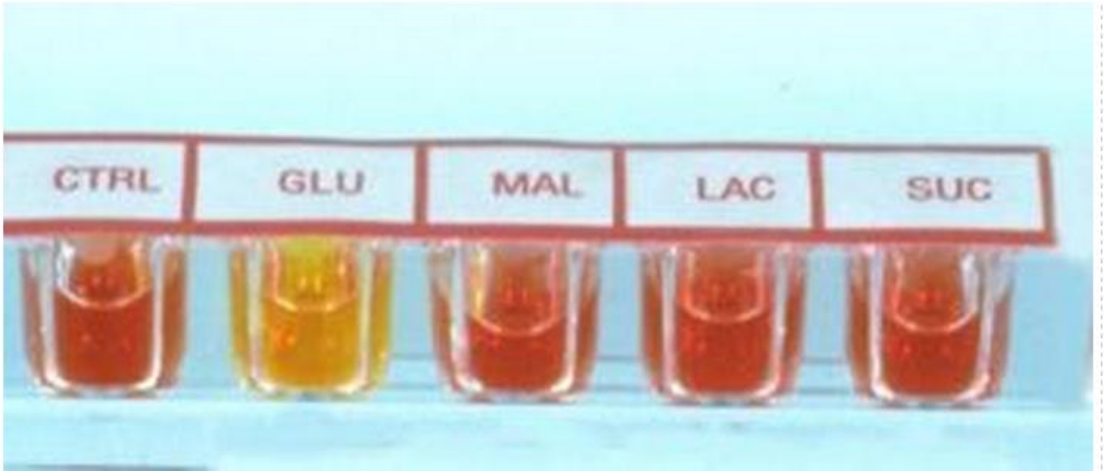
Colonies on chocolate agar are gray-brown, translucent and smooth.

Oxidase test positive: filter paper is saturated with one drop of dimethyl or tetramethyl oxidase reagent and then colony is rubbed onto the saturated area of filter paper. A dark purple color appearing in 10 sec.

Catalase test positive

Sugar oxidation patterns are used to distinguish *N. gonorrhoeae* from other N. spp. traditionally, CTA sugars were used (CAT: cystine-tryptic digest semisold agar based media which contain 1% carbohydrate and phenol red pH indicator. Glucose, maltose, lactose, and sucrose were the sugars usually tested.

Production of yellow color means positive result. *N. gonorrhoeae* will oxidize glucose but not maltose, lactose, sucrose, or fructose.



N. meningitidis: referred to as Meningococcus

Structure

Like *N. gonorrhoeae, N. meningitidis* is a nonmotile, gram-negative diplococcus, shaped like a kidney bean, which always appears in pairs. It is also piliated and the pili allow attachment of the organism to the ***nasopharyngeal mucosa*** where it is harbored both in carriers and in those with meningococcal disease. When meningococcus is isolated from blood or spinal fluid, it is **encapsulated**. The meningococcal polysaccharide capsule is antiphagocytic and, therefore, the most important virulence factor.

Transmission occurs through **inhalation of respiratory droplets** from a carrier or a patient in the early stages of the disease.

Risk factors for disease include recent viral or mycoplasma upper respiratory tract infection, active or passive smoking, and complement deficiency. In susceptible persons, pathogenic strains may invade the bloodstream and cause systemic illness after an incubation period of 2 to 10 days

Pathogenesis

Antiphagocytic properties of capsule aid in the maintenance of infection. LOS is responsible for the toxic effects found in disseminated meningococcal disease. IgA protease cleaves IgA1 helps the pathogens to evade immunoglobulins of this subclass.


Petechial and/or purpuric rash and neck extension characteristic of meningococcal meningitis.

Causes of meningitis (2-18 y major cause N.meningitidis , S. pneumonia, H influenza), frequent cause of neonatal meningitis are S. agalactiae, L. monocytogenes, E. coli. Viral meningitis is caused by enteroviruses, herpes simplex viruses.

Laboratory identification

Sedimented CSF and skin lesion aspirates (gram-negative diplococcic association with polymorphonuclear leukocytes.
Carriers can be detected by culturing swabs from the nasopharyngeal region.

Culture: on chocolate agar (if sample taken from blood and CSF which they are sterile) with increased CO2.
Note: Thayer-Martin medium is required for samples obtained from a skin lesion or nasopharyngeal swab, to eliminate contaminating organisms.

oxidase-positive.
sugar utilization tests: N. meningitidis utilizes both glucose and maltose,

CSF elevated protein, decreased glucose (partly resulting from its consumption as a bacterial nutrient), and many neutrophils.
The presence of an infecting organism or of antigenic capsular substance confirms the diagnosis.

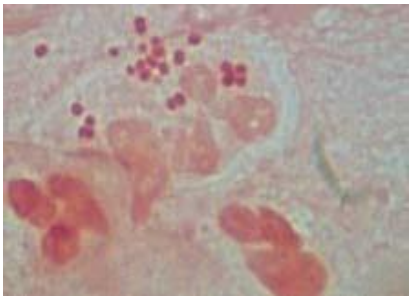
Prevention

A conjugate meningococcal vaccine **is available**

Moraxella catarrhalis

G –ve coccobacilli in pairs and sometimes in short chains. Moraxella catarrhalis *causes ear and upper and lower respiratory infections.*

Lab dx:



Direct smear from an otitis media sample

***Moraxella catarrhalis* growing on chocolate agar after 24 hours of incubation**

Oxidase positive, All CTA sugars negative, Produce beta- lactamase