Neisseria

Commensal Neisseria species lack several virulence factors, including pili, Opa proteins, and the H8 antigen, that are expressed by meningococci and gonococci and have an altered lipid A structure compared with that in the lipo-oligosaccharide of pathogenic Neisseria.

From: Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases (Eighth Edition), 2015

Related terms:

Pilus, Neisseria gonorrhoeae, Neisseria meningitidis, Gonorrhea, Protein, Phosphoprotein, Bacterium

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Neisseria

Tone Tønjum, Jos van Putten, in Infectious Diseases (Fourth Edition), 2017

Growth Characteristics

Neisseria spp. grow best aerobically in an atmosphere containing 5–10% carbon dioxide at a temperature of 89.6–98.6°F (32–37°C) and a pH of 7–7.5. Cell size ranges from 0.6 to 1.5 mm depending upon the species source of the isolate and the age of the culture.

Neisseria spp. are fastidious. Blood agar and chocolate medium (blood heated at 176–194°F/80–90°C) are suitable growth media. Bacterial colonies usually appear after 24–48 hours of growth. Colonies of N. gonorrhoeae are 0.5–1 mm in size. Colonies of *N. meningitidis* are usually larger (1–2 mm) and flatter. Colonies of the nonpathogenic *Neisseria* spp. are similar in size, appearance and consistency, except for the saccharolytic *Neisseria* spp. (*N. subflava*, *N. sicca* and *N. mucosa*) that are larger (1–3 mm), more convex and smooth (*N. mucosa*). Colonies of *N. subflava* and *N. sicca* are opaque and have varying consistency. *N. sicca* adhere to the agar surface and become wrinkled with prolonged incubation. Some nonpathogenic *Neisseria*

spp. form a yellow pigment (*N. flavescens*) or a greenish-yellow pigment (*N. mucosa*, *N. subflava*).

Neisseria spp. are oxidase positive and catalase positive, except *N. elongata*, which is catalase negative. All species produce acid from a few carbohydrates by oxidation. The ability to produce polysaccharide from sucrose, to produce catalase and deoxyribonuclease, to reduce nitrate and nitrite, and to oxidize the tributyrin fatty acid can also be used to identify *Neisseria* spp.

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NEISSERIA

S.A.S. Hanna, in Encyclopedia of Food Microbiology, 1999

Bacterial Characteristics

Neisseria spp. are a Gram-negative non-spore-forming diplococcus that has a flattened shape; its size ranges between 0.6–0.8 μm. They are oxidase-positive, non-acid-fast cocci or plump rods. They can reach a diameter of around 0.6–0.8 μm and sometimes up to 1.0 × 2.0–3.0 μm. The cocci often occur in pairs with adjacent sides flattened, giving them a typical kidney-bean shape. They are non-motile aerobes and some are microaerophilic or facultative anaerobes. They are non-halophilic; some have an optimal growth temperature of around 37°C. They need blood or ascitic fluid for growth as well as increased carbon dioxide pressure. Neisseria spp. have a very well-advanced functioning tricarboxylic acid cycle with the ability to use Enter–Doudoroff and pentose shunt. The Embden–Meyerhof (EM) enzymes are present, but this pathway is not extensively used and probably not used at all in aerobic conditions. Fermentation of sugars will mainly result in acid formation from glucose; however, some strains have the ability to produce acids from other sugars.

Genetically the DNA composition is made up from 49–56 mol% from guanine + cytosine (G+C). Genetic studies have shown that a relationship does exist between *Neisseria* spp., especially between *N. meningitidis* and *N. flavescens*; in certain condition *N. flavescens* can cause meningitis which cannot be treated in the usual manner. *N. flavescens* was isolated from food and dairy products: it is possible that it is a mutant form of *N. meningitidis* which can cause meningitis. This genetic analysis is being used as the most certain method to confirm where bacterial types belong to a specific family, it is somewhat more accurate than other procedures.

N. meningitidis is a common commensal organism of the human nasopharnyx; it has not as yet been isolated from animals or environmental sources. This bacterium is

fastidious: optimal growth takes place in a moist environment with temperatures between 35 and 37°C in an atmosphere of around 5–10% carbon dioxide.

The other important feature of this bacterial group is the presence of pili, which aid in invasion of host cells, and are an adherence factor. Some *Neisseria* produce endotoxins due to the presence of lipo-oligosaccharides and proteins in their outer membranes. *N. gonorrhoeae* differ from other *Neisseria* by their ability to ferment glucose but not maltose or lactose. The cell wall of *Neisseria* contains the enzyme cytochrome oxidase – which is why the oxidase test result given by this bacteria is positive.

> Read full chapter

Neisseria

SCOTT D. GRAY-OWEN, ... THOMAS F. MEYER, in Principles of Bacterial Pathogenesis, 2001

4. OPA-MEDIATED BINDING TO INTRACELLULAR PYRUVATE KINASE

Although intracellular gonococci are generally considered to remain inside a phagosomal compartment, occasional reports indicate that they may have the capacity to escape into the cytoplasm [239]. Recently, gonococcal Opa proteins were reported to bind human pyruvate kinase (PK) subtype M2 *in vitro*, and this cytoplasmic enzyme appears to associate with intracellular Opa-expressing gonococci [240]. PK catalyzes the irreversible conversion of phosphoenolpyruvate to pyruvate with the resulting generation of ATP. Interestingly, a N. gonorrhoeae mutant that is unable to use pyruvate or lactate is unaffected in its uptake into epithelial cells, but does not survive intracellularly [240]. It is thus possible that intracellular gonococci bind PK to gain an ample source of pyruvate, one of only three carbon sources known to be used by *N. gonorrhoeae*. Whether pyruvate does actually play a role in intracellular survival of Neisseria spp. *in vivo*, however, is still unknown.

> Read full chapter

Neisseria gonorrhoeae (Gonorrhea)

Jeanne M. Marrazzo, Michael A. Apicella, in Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases (Eighth Edition), 2015

Plasmids

Many gonococci possess a 24.5-mDa conjugative plasmid and can thereby conjugally transfer other non–self-transferable plasmids with high efficiency; chromosomal genes are not mobilized. Many gonococci carry a plasmid (Pc_r) that specifies production of a TEM-1 type of □-lactamase (penicillinase). The two most common Pc_r plasmids have molecular weights of 3.2 and 4.4□mDa and are closely related to each other and to similar plasmids found in certain Haemophilus spp., including Haemophilus ducreyi. In fact, it is suspected that gonococci first acquired Pc_r plasmids from *H. ducreyi*.[28] Pc_r plasmids are commonly mobilized to other gonococci by the conjugative plasmid.

Gonococci with plasmid-mediated high-level resistance to tetracycline, with minimal inhibitory concentrations (MICs) of 16□mg/L or greater, carry the 24.5-mDa conjugative plasmid into which the *tetM* transposon has been inserted.[29] The *tetM* determinant also confers tetracycline resistance to a variety of other bacteria, including some Streptococcus and Mycoplasma spp. and various genital organisms such as Gardnerella vaginalis and Ureaplasma urealyticum. Because of its location on the conjugative plasmid, high-level tetracycline resistance is readily transferred among gonococci. The *tetM* determinant functions by encoding a protein that protects ribosomes from the effect of tetracycline. Finally, all gonococci contain a small (2.6□mDa) cryptic plasmid of unknown function.

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Etiologic Agents of Infectious Diseases

Katherine K. Hsu, Jay M. Lieberman, in Principles and Practice of Pediatric Infectious Diseases (Fourth Edition), 2012

Microbiology and Laboratory Diagnosis

Neisseria species are gram-negative, oxidase-positive bacteria. All are catalase-positive, except *N. bacilliformis* and *N. elongata*. All are diplococci, except *N. bacilliformis*, *N. elongata*, and *N. weaveri*. Whereas meningococci and gonococci require additional carbon dioxide for optimal growth and grow only at temperatures of 30°C to 37°C, the other species are less fastidious; they do not require extra carbon dioxide and can grow at 22°C to 25°C. Unlike *N. meningitidis* and N. gonorrhoeae, the other Neisseria species (except *N. lactamica*) generally do not grow on selective media such as Thayer–Martin agar. The commensal species can be distinguished from *N. meningitidis* and *N. gonorrhoeae* by biochemical and serologic tests. Carbohydrate

utilization reactions, production of polysaccharide from sucrose, and reduction of nitrate are commonly used for identification (Table 127-1).[2–5] Difficulties in accurate identification of certain species resulted in some confusion and incorrect identifications in earlier literature.[2]

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Other Neisseria Species

Zoon Wangu, Katherine K. Hsu, in Principles and Practice of Pediatric Infectious Diseases (Fifth Edition), 2018

Microbiology and Laboratory Diagnosis

Neisseria species are gram-negative, oxidase-positive bacteria. All are catalase positive, except some strains of *N. bacilliformis* and *N. elongata*. All are diplococci, except *N. bacilliformis* and *N. elongata*. Whereas meningococci and gonococci require additional carbon dioxide for optimal growth and grow only at temperatures of 30°C to 37°C, the other species are less fastidious, growing without added carbon dioxide and at 22°C to 25°C. Unlike N. gonorrhoeae and *N. meningitidis*, the other Neisseria species (except *N. lactamica*) generally do not grow on selective media such as Thayer-Martin agar; LBVT.SNR medium is used to isolate commensal species.[4] Commensal and pathogenic species usually can be distinguished by biochemical and serologic tests. Carbohydrate use reactions, production of polysaccharide from sucrose, and reduction of nitrate are commonly used for identification (Table 127.1).[2–6] Difficulties in accurate identification of certain species resulted in some confusion and incorrect identifications in earlier published reports.[2]

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INFECTIONS WITH SPECIFIC MICROORGANISMS

Charles R. WoodsJr., in Feigin and Cherry's Textbook of Pediatric Infectious Diseases (Sixth Edition), 2009

GENETIC CHARACTERISTICS

Gonococci have a circular chromosome consisting of 2219 kilobases (kb), which is about half the size of the *Escherichia coli* genome.[107] The gonococcal genome

has approximately 2250 predicted open-reading frames (ORFs).[35] The entire *N. gonorrhoeae* strain FA1090 has been sequenced. A macrorestriction map with the positions of many genetic markers has been available since 1991.[199,257] More than 1300 ORF sequences have been validated.[35]

Piliated gonococcal cells (the natural in vivo state) are competent for genetic transformation by exogenous DNA at all stages of growth.[25] Only homologous DNA is taken into the cell.[114] Gonococci are highly autolytic and release DNA in a biologically active form. Thus, different strains are able to exchange genetic material readily. Such exchange can lead to further genetic and phenotypic diversity, which helps maintain the species in its human hosts and facilitates transfer of chromosomal antibiotic resistance genes.[291]

A 36-kb conjugal plasmid is present in many gonococci. It efficiently mobilizes its own transfer and other non–selfmobilizable plasmids (e.g., the 4.5- and 7.5-kb penicillinase plasmids), but not chromosomal genes.[24,253,279] Extrachromosomal, non-plasmid DNA circles recently have been identified in wild-type gonococcal isolates. They may play a role in gene recombination, amplification of chromosomal genes, and transformation.[18]

Gonococci possess multiple restriction endonucleases and their corresponding DNA methylases.[317] No bacteriophages for *N. gonorrhoeae* are known, and no drug resistance transposon systems have been identified.[308] The species is relatively nonmutagenic and lacks photoreactivation and error-prone repair systems.[48]

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