Shigella

Shigella is a common cause of bacterial diarrhea worldwide. Shigella is differentiated from other Gram negative bacteria because it is an oxidase negative, lactose nonfermenting bacterium that does not produce H₂S. It can be grown on MacConkey’s agar in white colonies. In the USA, shigellosis predominantly affects children and is often spread in areas with crowded conditions (like day care centers). Transmission is via direct person-to-person contact and contaminated foods and water. Shigella has a high virulence; as few as 10-100 bacteria can cause disease because the organisms can survive the stomach’s acidic conditions. Once in the intestines, shigella is taken up into cells which allow the bacteria to evade the host’s immune system and protect itself from the intestinal lumen. It replicates intracellularly in intestinal cells and have “actin rockets” that project from the cell surface to allow shigella to be taken up into adjacent cells. This mucosal invasion causes damage to the GI tract and results in bloody diarrhea. In addition, Shigella produces shiga toxin, which inactivates the 60S ribosomal subunit by cleaving rRNA and also enhances cytokine release. This extensively damages mucosal cells and the cytokine release can cause hemolytic uremic syndrome (HUS), which is potentially fatal. HUS is characterized by microangiopathic hemolytic anemia, thrombocytopenia and acute renal failure. HUS is typically caused by shiga toxin-producing bacteria, including Shigella and E. coli O157:H7.



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Characteristics

Gram-Negative
Graham-cracker Negative-devil
Shigella is a Gram negative bacteria. In a Gram stain test, Gram negative bacteria are colored red because it has an outer membrane made of lipopolysaccharides.

Bacilli
Rod
Shigella is a bacilli, meaning it is a rod-shaped bacterium.

Non Lactose Fermenting
Nun-milk-carton Ferns
Shigella is categorized as a lactose nonfermenter because it cannot utilize lactose sugars in culture. This is relevant because it separates Shigella (and a few other bacteria) from many of the normal flora of the colon, most of which ferment lactose, such as E. coli and Enterobacter.

White on Macconkey Agar
White Monkey Petri-dish
MacConkey's agar is used to culture Gram-negative bacteria and differentiate between them using lactose fermentation. Shigella is a lactose nonfermenter, so colonies appear white or colorless.

Oxidase Negative
Wilting Ox-daisy
The oxidase test is used to determine if a bacterium produces certain cytochrome c oxidases in order to use oxygen for energy production. Shigella is oxidase negative, meaning it does not use the electron transport chain to make energy.

Non H2S Producing
Nun with H-shaped Sulfur-match
Shigella does not produce H2S (hydrogen sulfide), which allows it to be differentiated from other oxidase negative Gram-negative bacteria, like Salmonella and Proteus.

Day Care Centers
Day care kids with toys
In the United States, shigellosis predominantly affects children and is often spread at day care centers or other areas with crowded conditions. Transmission of shigella is via direct person-to-person contact and contaminated foods, so hand-washing is paramount.

High Virulence
Drop of Toxin changing waters
Shigella has a high virulence; as few as 10-100 bacteria can cause disease because the organisms can survive the stomach's acidic conditions.

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Replicates Intracellularly

Bursting through Cell

Shigella replicates intracellularly in intestinal cells, which allows the bacterium to evade the host's immune system and protect itself from the intestinal lumen.

Actin Rocket

Actin rocket

Shigella has membrane-bound projections made of actin that extend out and allow the bacterium to be taken up into adjacent cells. These projections are called actin rockets because they allow speedy movement from cell to cell and at the same time evade the host's immune system.

Signs and Symptoms

Bloody Diarrhea

Red Toilet

Shigella can cause bloody diarrhea because the bacteria invades host cells and causes mucosal damage.

Shiga Toxin

She-jello with Toxic-green-glow

Shigella produces shiga toxin, which inactivates the 60S ribosomal subunit by cleaving rRNA and also enhances cytokine release. This damages mucosal cells in the gastrointestinal tract and the cytokine release can cause hemolytic uremic syndrome (HUS), which is potentially fatal. A shiga-like toxin is made by E. coli O157:H7 and has the same mechanism.

Inhibits 60S Ribosome

She-jello Biting into 60 S Ribosome

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Hemolytic Uremic Syndrome (HUS)

(HUS) Hemolysing U-rainbow Anemone

Hemolytic uremic syndrome (HUS) is a potentially fatal multisystem disease with microangiopathic hemolytic anemia, thrombocytopenia and acute renal failure. HUS is typically caused by shiga toxin-producing bacteria, including Shigella and E. coli O157 H7.

Hemolytic Anemia

Hemolysing-RBCs from Anemone

Hemolytic anemia is the destruction of RBCs due to inherited or acquired causes. Hemolytic anemia can cause fatigue, shortness of breath and jaundice due to the excess breakdown of red cells. Hemolytic uremic syndrome (HUS) causes microangiopathic hemolytic anemia, which is the destruction of red blood cells due to vascular endothelial dysfunction and narrowing of blood vessels which shears through RBCs.

Thrombocytopenia

Trombone-side-toe-peanut

Thrombocytopenia is a relative decrease of platelets in the blood (fewer than 150,000 platelets per microliter of blood). Platelets are needed for hemostasis and if there is thrombocytopenia, excessive bleeding can occur. HUS presents with thrombocytopenia and microangiopathic hemolytic anemia.

Kidney Failure

Damaged kidney

Hemolytic uremic syndrome can cause acute kidney failure. In HUS, shiga toxin enhances the release of cytokines which damages endothelial cells in the vasculature and kidneys. This damage can cause the kidneys to fail.

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