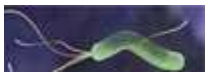
Helicobacter pylori

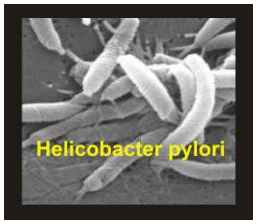
Helicobacter is a pathogenic gram negative bacterium that inhabits the inner lining of human stomach and causes inflammation and ulcers. Majority of persons infected with H.pylori remains asymptomatic till the symptoms appear. Originally this bacterium was named as **Campylobacter pyloridis** and later placed in the genus **Helicobacter**. Its species name is given as **pylori** since it inhabits the **Pylorus** which is the opening of stomach into the duodenum.



H.pylori has a **Spirally coiled** body having 3 mm length and 0.5 mm diameter. It is **Micro aerobic bacterium** and can live in low level oxygen. The presence of **Hydrogenase enzyme** in its body facilitates the utilization of **Hydrogen** molecules released by the intestinal bacteria for energy production.

Structure

The body of H.pylori is surrounded by 5 kinds of **Membrane Proteins** families. The most abundant one is **Putative Adhesins**. In addition to this, there are proteins like **Porins**, **Flagellum associated proteins** etc. The outer membrane also has Phospholipids, Lipopolysaccharides, Cholesterol glucosides etc. Helicobacter is **highly motile** and has 4 to 6 sheathed flagella. The Flagellum is composed of protein **Flagellins FlaA** and **FLa B**. The genome of Helicobacter consists of 1.7 million Base pairs in 1550 genes.

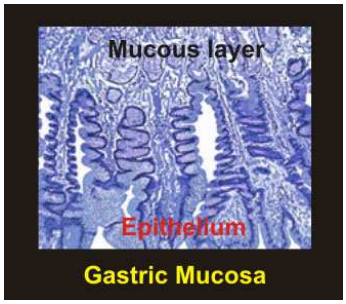


The Pathogenicity of the helicobacter is related to its genetic make up and a **40kb long gene** sequence is responsible for its Pathogenicity. The 40 genes containing area in the genome is called **Pathogenicity Island**. A gene called **cagA** codes for the **virulence protein** which is the major cause of ulcer formation in human

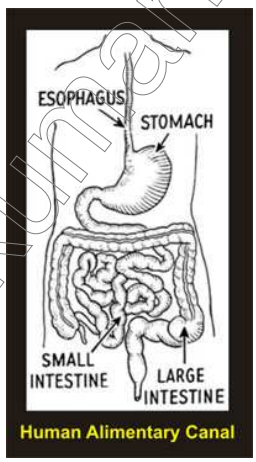
beings. This protein is relatively long having 1186 amino acids. The Pathogenicity Island also has a 30 gene area which code for **Type IV secretion system**.

Helicobacter and Ulcer formation

Helicobacter is highly motile and penetrates through the mucous lining of the stomach into the epithelium.

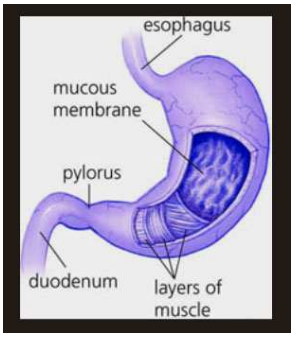


The stomach pH is highly acidic and the Helicobacter can sense the pH of mucous lining through chemotaxis to inhabit in the deeper layers of epithelium which has a neutral pH. After reaching the epithelium, helicobacter secretes **Adhesins** to adhere on the epithelial cells. Adhesin is a combination of lipids and carbohydrates. One typical Adhesin is **BabA**.



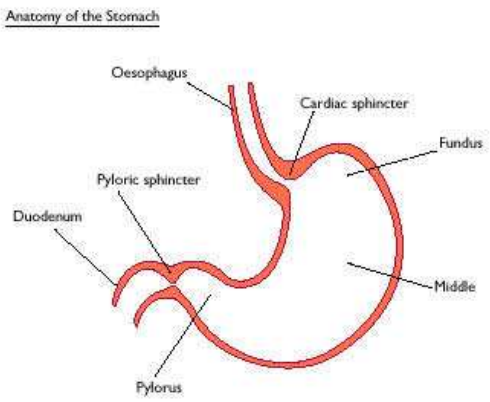
The survival of Helicobacter in the stomach depends on the presence of **Urease enzyme** in its body. The Urease enzyme helps to degrade the Urea in the stomach into **Carbon dioxide** and **Ammonia**. Ammonia is then converted into **Ammonium** leaving hydroxyl ions. **Hydroxyl ions** then react with carbon di oxide to produce **Bicarbonates**. This bicarbonate is basic salts which neutralize the acid of stomach.

This facilitates the easy colonization of Helicobacter in a neutral pH area. The damage of stomach epithelium is mainly due to the production of Ammonia by the helicobacter. Along with ammonia, the secretions like **Proteases**, **Vacuolating cytotoxin A**, and **Phospholipids** destroy the epithelial cells causing ulcers. The Helicobacter Cysteine rich proteins – **Hcp**- trigger the immune response and cause the differentiation of **Myeloid Thp 1** Monocytes into Macrophages.



Chronic Gastritis

Chronic gastritis is the inflammation of the stomach lining caused by the colonization of Helicobacter. The **Type IV secretion system** of Helicobacter injects the inflammation inducing factor called **Peptidoglycan** into the epithelial cells of the stomach. The Peptidoglycan also destroys the Cell Adhesion proteins and Cell Signaling mechanism. The inflammation reduces the protective mechanism of the stomach lining that prevents the acid attack. As a result, **Hydrochloric acid** and **Pepsin** (Protein digesting enzyme) from stomach lumen penetrates into the epithelium resulting in **ulcer** formation in the stomach and Duodenum.



Mainly the Helicobacter colonizes the **Antrum** part of the stomach where acid secreting cells are minimum. As a result of colonization of Helicobacter in the antrum, **G cells** in the antrum secrete more **Gastrin hormone** which passes into the body of stomach and release more acid. This increased level of acid and destroys the wall of the stomach and duodenum resulting in ulcers. Helicobacter also causes gastritis if the acid production is very low. In such cases, Helicobacter can inhabit in the main body of stomach also. Colonization of Helicobacter in the areas of low acid secreting cells result in inflammation and ultimately leads to the atrophy of stomach lining.

The enhanced production of **Free radicals** by the Helicobacter colonization induces **Mutation** in the epithelial cells which is considered as one of the possible mechanism inducting stomach cancer. The inflammation associated signaling molecules like **TNF alpha** reduces the cell adhesion and allow the movement of mutated cells into other areas of the alimentary canal.

Detection of Helicobacter infection

Helicobacter infection can be detected using the following tests

1. Blood antibody test
2. Stool Antigen test
3. **Carbon Urea breath test**- In this test, the patient takes ^{14}**C** or ^{13}**C** labeled Urea. The Helicobacter metabolizes this labeled urea and produces carbon dioxide containing the ^{14}C or ^{13}C which can be detected in the breath.
4. **Endoscopy**- This is the most reliable method and uses the endoscope to collect the biopsy of the gastric lining for histological examination.