

was recognized. More than 15 species have since been identified. These species are currently divided into three genera: *Campylobacter*, *Arcobacter*, and *Helicobacter*. Not all of the species are pathogens of humans. The human pathogens fall into two major groups: those that primarily cause diarrheal disease and those that cause extraintestinal infection. The principal diarrheal pathogen is *Campylobacter jejuni*, which accounts for 80–90% of all cases of recognized illness due to campylobacters and related genera. Other organisms that cause diarrheal disease include *Campylobacter coli*, *Campylobacter upsaliensis*, *Campylobacter lari*, *Campylobacter hyointestinalis*, *Campylobacter fetus*, *Arcobacter butzleri*, *Arcobacter cryaerophilus*, *Helicobacter cinaedi*, and *Helicobacter fennelliae*. The two *Helicobacter* species causing diarrheal disease, *H. cinaedi* and *H. fennelliae*, are intestinal rather than gastric organisms; in terms of the clinical features of the illnesses they cause, these species most closely resemble *Campylobacter* rather than *Helicobacter pylori* (Chap. 188) and thus are considered in this chapter. The pathogenic roles of *Campylobacter concisus*, *Campylobacter ureolyticus*, *Campylobacter troglodytis*, and *Campylobacter pyloridis* are uncertain. A new subspecies—*C. fetus* subspecies *testudinum*—has been described, chiefly in Asian patients; its close resemblance to strains isolated from reptiles suggests a food source.

The major species causing extraintestinal illnesses is *C. fetus*. However, any of the diarrheal agents listed above may cause systemic or localized infection as well, especially in compromised hosts. Neither aerobes nor strict anaerobes, these microaerophilic organisms are adapted for survival in the gastrointestinal mucous layer. This chapter focuses on *C. jejuni* and *C. fetus* as the major pathogens in and prototypes for their groups. The key features of infection are listed by species (excluding *C. jejuni*, described in detail in the text below) in Table 192-1.

EPIDEMIOLOGY



Campylobacters are found in the gastrointestinal tract of many animals used for food (including poultry, cattle, sheep, and swine) and many household pets (including birds, dogs, and cats). These microorganisms usually do not cause illness in their animal hosts. In most cases, campylobacters are transmitted to humans in raw or undercooked food products or through direct contact with infected animals. In the United States and other developed

countries, ingestion of contaminated poultry that has not been sufficiently cooked is the most common mode of acquisition (30–70% of cases). Other modes include ingestion of raw (unpasteurized) milk or untreated water, contact with infected household pets, travel to developing countries (campylobacters being among the leading causes of traveler's diarrhea; Chaps. 149 and 160), oral-anal sexual contact, and (occasionally) contact with an index case who is incontinent of stool (e.g., a baby).

Campylobacter infections are common. Several studies indicate that, in the United States, diarrheal disease due to campylobacters is more common than that due to *Salmonella* and *Shigella* combined. Infections occur throughout the year, but their incidence peaks during summer and early autumn. Persons of all ages are affected; however, attack rates for *C. jejuni* are highest among young children and young adults, whereas those for *C. fetus* are highest at the extremes of age. Systemic infections due to *C. fetus* (and to other *Campylobacter* and related species) are most common among compromised hosts. Persons at increased risk include those with AIDS, hypogammaglobulinemia, neoplasia, liver disease, diabetes mellitus, and generalized atherosclerosis as well as neonates and pregnant women. However, apparently healthy nonpregnant persons occasionally develop transient *Campylobacter* bacteremia as part of a gastrointestinal illness.

In contrast, in many developing countries, *C. jejuni* infections are hyperendemic, with the highest rates among children <2 years old. Infection rates fall with age, as does the illness-to-infection ratio. These observations suggest that frequent exposure to *C. jejuni* leads to the acquisition of immunity.

PATHOLOGY AND PATHOGENESIS



C. jejuni infections may be subclinical, especially in hosts in developing countries who have had multiple prior infections and thus are partially immune. Symptomatic infections mostly occur within 2–4 days (range, 1–7 days) of exposure to the organism in food or water. The sites of tissue injury include the jejunum, ileum, and colon. Biopsies show an acute nonspecific inflammatory reaction, with neutrophils, monocytes, and eosinophils in the lamina propria, as well as damage to the epithelium, including loss of mucus, glandular degeneration, and crypt abscesses. Biopsy findings may be consistent with Crohn's disease or ulcerative colitis, but these "idiopathic"

TABLE 192-1 CLINICAL FEATURES ASSOCIATED WITH INFECTION DUE TO "ATYPICAL" *CAMPYLOBACTER* AND RELATED SPECIES IMPLICATED AS CAUSES OF HUMAN ILLNESS

Species	Common Clinical Features	Less Common Clinical Features	Additional Information
<i>Campylobacter coli</i>	Fever, diarrhea, abdominal pain	Bacteremia ^a	Clinically indistinguishable from <i>C. jejuni</i>
<i>Campylobacter fetus</i>	Bacteremia, ^a sepsis, meningitis, vascular infections	Diarrhea, relapsing fevers	Not usually isolated from media containing cephalothin or incubated at 42°C
<i>Campylobacter upsaliensis</i>	Watery diarrhea, low-grade fever, abdominal pain	Bacteremia, abscesses	Difficult to isolate because of cephalothin susceptibility
<i>Campylobacter lari</i>	Abdominal pain, diarrhea	Colitis, appendicitis	Seagulls frequently colonized; organism often transmitted to humans via contaminated water
<i>Campylobacter hyointestinalis</i>	Watery or bloody diarrhea, vomiting, abdominal pain	Bacteremia	Causes proliferative enteritis in swine
<i>Helicobacter fennelliae</i>	Chronic mild diarrhea, abdominal cramps, proctitis	Bacteremia ^a	Best treated with fluoroquinolones
<i>Helicobacter cinaedi</i>	Chronic mild diarrhea, abdominal cramps, proctitis	Bacteremia ^a	Best treated with fluoroquinolones; identified in healthy hamsters
<i>Campylobacter jejuni</i> subspecies <i>doylei</i>	Diarrhea	Chronic gastritis, bacteremia ^b	Uncertain role as human pathogen
<i>Arcobacter cryaerophilus</i>	Diarrhea	Bacteremia	Cultured under aerobic conditions
<i>Arcobacter butzleri</i>	Fever, diarrhea, abdominal pain, nausea	Bacteremia, appendicitis	Cultured under aerobic conditions; enzootic in nonhuman primates
<i>Campylobacter sputorum</i>	Pulmonary, perianal, groin, and axillary abscesses; diarrhea	Bacteremia	Three clinically relevant biovars: <i>sputorum</i> , <i>faecalis</i> , and <i>paraureolyticus</i>

^aIn immunocompromised hosts, especially HIV-infected persons. ^bIn children.

Source: Adapted from BM Allos, MJ Blaser. Clin Infect Dis 20:1092, 1995.