CAMPYLOBACTER JEJUNI & RELATED ORGANISMS

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Historical aspects and contemporary problems

McFadyean & Stockman, British veterinarians, epizootic abortion in ewes (1909)
Theobald Smith, investigating infectious abortions of U.S. cattle (1919): Vibrio fetu
Jones, Little, & Orcutt, winter dysentery in U.S. calves (1931): Vibrio jejuni
Doyle, swine dysentery (1944)
Humans: acute milkborne diarrhea, Vibrio jejuni (Levy, 1946); abortion in two women, Vibrio fetus (Vinzent, 1947)
King (1957): Vibrio fetus differentiated from “related vibrios”
Sebald and Veron (1963): differentiation from cholera and halophilic vibrios → genus Campylobacter (“curved rod”)
C. jejuni and less often C. coli now recognized as leading (perhaps foremost bacterial) causes of diarrhea in humans; a classical zoonosis — sometimes cause animal disease, but are often a commensal in animals
U.S., 1993–1997: Campylobacter spp. ranked #11 among total foodborne illnesses caused in recorded outbreaks for which an etiology was determined (ca. 25 outbreaks comprising ca. 539 cases)
CAST (1994) estimates (various sources of estimates) 170,000 to 2,100,000 cases per year, with 120 to 360 deaths — presumably all foodborne; the average medical and productivity cost per case is estimated at $920, with an annual total near $1 billion
CDC (1999) ~2 million foodborne illnesses, >10 thousand hospitalizations, 100 deaths
FoodNet (2004): second leading cause (after Salmonella) of diagnosed illness in study area

Characteristics of Campylobacter

Classification — small, nonsporeforming, gram-negative bacteria, curved, S-shaped, or spiral; 0.5–8 μm long, 0.2–0.9 μm diameter; single polar flagellum at one or both ends, rapid, darting, corkscrew-like motility; require reduced O2 for growth (microaerophilic; aerotolerant = Arcobacter), increased CO2 (capnophilic); C. jejuni growth optimum = 42°C, minimum 30°C, maximum ca. 45°C, thermal inactivation from 48°C, survives well at 4°C in milk and water; many species and subspecies; many serotypes of C. jejuni, based on somatic, capsular, and flagellar antigens
Virulence factors and their genetic basis — pathogenesis is poorly understood; both enterotoxigenic and enteroinvasive strains may exist
Ability to survive and grow in the environment — labile to freezing, drying, and temperatures from 48°C up; stable at 4°C, dies more quickly at 25°C than at 4° or 30°C; some losses at atmospheric levels of O2; growth above pH 4.9, good at 5.5 to 8, optimum at 6.5–7.5; optimum salt level 0.5%
FIGURE 1. Incidence* of diagnosed infections, by pathogen and site — Foodborne Diseases Active Surveillance Network¹, United States, 2000

*Per 100,000 population.
¹ Reporting was statewide in Connecticut, Georgia, Minnesota, and Oregon, and from selected counties in California, Maryland, New York, and Tennessee.

FIGURE 2. Incidence* of diagnosed Campylobacter infections at the five original sites, by year — Foodborne Disease Active Surveillance Network, United States, 1996–2000

* Per 100,000 population
Nature of the infection

Humans — unusual in affecting young adults as often as infants and elderly (fatal outcomes more common in infants, elderly, immune impaired)

Human disease 90% from C. jejuni, also C. coli; infectious dose is apparently “small” (<1000 organisms)

Incubation 2–5 (1–10) days; duration 2–5 days, sometimes 10 days; sequelae (e.g., Guillain-Barré syndrome, reactive arthritis) possible

Diarrhea (watery to bloody with pus & WBC), abdominal pain, malaise, fever, nausea, and vomiting; possible typhoid-like syndrome, rarely febrile convulsions, Guillain-Barré syndrome, or meningitis; may mimic acute appendicitis; many infections asymptomatic

Shedding 2–7 weeks if antibiotic treatment is not done; minor source of human infection, except for an occasional food worker contaminating food

Lasting immunity follows infection

Animals — frequently infected, often asymptptomatically

Reservoirs and transmission — common in cattle, swine, sheep, and especially poultry (also companion animals and rodents); carried in gall bladder and large and small intestines; shed in feces, which may contaminate edible portions of carcass; occurrence in milk may indicate shedding via the mammary gland, but mastitis is seldom involved.

Prevalence of Campylobacter in foods, feed, and water

Eggs — not mentioned as a vehicle in outbreaks

Poultry — up to 100% positives in retail poultry (lower in some surveys), evidently due to fecal cross-contamination in post-slaughter processing

Meat — most common on swine carcasses; sometimes present on beef and lamb carcasses

Milk and milk products — readily killed by pasteurization; raw milk is a leading vehicle in U.S.

Other foods — mainly animal products, though fertilization of vegetables with manure may cause contamination

Animal feed — subject to contamination from bird and rodent droppings

Water — caused three drinking water-associated in outbreaks in U.S., 1999–2000, from well, spring, and irrigation water (a football team in California drank irrigation water after a practice)

Foods most often associated with human infections — U.S., raw milk, poultry, other foods via cross-contamination
Principles of detection of Campylobacter

Samples ideally stored at 4°C in a N₂ atmosphere, with 0.01% sodium bisulfite added

Expect low contamination levels: pre-enrichment likely to be necessary

This is a slow-growing organism, so isolation medium must be selective, to inhibit competitors.

Optimum atmosphere is 5% O₂, 10% CO₂, 85% N₂; candle jars are marginally useful

Incubation generally 42°C

Antibiotics used in some selective media may inhibit some strains of C. jejuni, also C. coli; cefaperazone is presently recommended, to the exclusion of cephalothin

Identification: gram-negative, appropriate appearance, growth at appropriate temperature in appropriate atmosphere; oxidase and catalase positive; hydrolyzes hippurate and indoxyl acetate; reduces nitrate; produces H₂S; tests for some of these properties require special precautions

Nonculture detection methods and epidemiologic typing systems are available

Related organisms:

Arcobacter (1991,1992) — first differentiated as “aerotolerant Campylobacter”; grow at 15, 25, and 30°C, but variably at 37 and 42°C; similar appearance (gram negative, curved, S-shaped, or helical; single polar flagellum, 1–3 μm long, 0.2–0.9 μm diameter; may grow aerobically at 30°C and anaerobically at 35–37°C

“Frequently isolated from cattle and pigs suffering from abortion and enteritis”

Human illnesses from two of the species include bacteremia, endocarditis, peritonitis, and diarrhea

Helicobacter pylori — discovered in 1982, separated from genus Campylobacter in 1989; looks like Campylobacter, microaerophilic, optimum growth at 37°C; culture characteristics, etc., need not be discussed here

Clinically important as probable cause of chronic gastritis and peptic and duodenal ulcer in humans

Human infection is widespread (nonhuman reservoirs of this species unknown); shed with feces and may contaminate food, but foodborne transmission is not clearly established

Bibliography


