

CLOSTRIDIUM PERFRINGENS

PATHOGEN SAFETY DATA SHEET - INFECTIOUS SUBSTANCES

INFECTIOUS AGENT

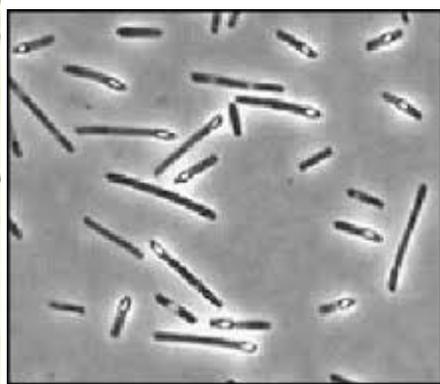
NAME: *Clostridium perfringens*

SYNONYM OR CROSS REFERENCE: Gas gangrene; pigbel disease

CHARACTERISTICS: *Clostridium perfringens*, of the *Clostridiaceae* family, is non-motile, anaerobic, (few strains are aerotolerant), spore forming Gram positive bacteria (subterminal spores) that are encapsulated in tissue smears. Vegetative cells are rod shaped, pleomorphic, and occur in pairs or short chains. It is catalase and superoxide dismutase negative, and has 5 toxigenic types (A-E), of which A and C strains are pathogenic for humans. It produces many different toxins. Colonies with double zone of hemolysis are produced when cultured at 37°C on blood agar overnight.



Clostridium perfringens, gram-stained¹⁾



Clostridium perfringens cells and spores²⁾

HAZARD IDENTIFICATION

PATHOGENICITY/TOXICITY: Clostridial Food Poisoning: Food poisoning can be caused by *C. perfringens* enterotoxin (cpe) produced by *C. perfringens* spores in the small intestine, which can germinate in foods such as meat and poultry. In the United States consumption of large amounts of *C. perfringens* is considered an important cause of watery diarrhea. Main symptoms of the disease are nausea, abdominal pain, and diarrhea. The disease is usually mild and self-limiting in healthy individuals, with symptoms resolving within 24 hours.

Clostridial Myonecrosis (Gas Gangrene): *C. perfringens* is the most common cause of clostridial myonecrosis. The disease involves breakdown of muscle tissue due to the action of potent exotoxins, alpha and theta, produced by the bacteria. It is manifested by severe pain, edema, tenderness and pallor, followed by discoloration and hemorrhagic bullae, and production of gas at the site of wound. Systemic manifestations of the disease include shock, renal failure, hypotension, bacteremia with intravascular hemolysis leading to coma and death.

Clostridial Cellulitis: *C. perfringens* is the most common cause of clostridial cellulitis, which is often associated with local trauma or recent surgery. Infection is less systemic than in clostridial myonecrosis, with localized infection and associated skin and soft tissue necrosis, but sparing of the fascia and deep muscles.

Enteritis Necroticans (pigbel): Enteritis necroticans is a life threatening infection involving ischemic necrosis of the jejunum. The often fatal disease is caused by *C. perfringens* type C, and is marked by hemorrhagic, inflammatory, or ischemic necrosis of the jejunum. Most cases occur sporadically, during outbreaks, or in underdeveloped countries.

Central nervous system (CNS) manifestations of *C. perfringens* infection are rare. The main manifestations of *C. perfringens* infection in CNS are meningitis and encephalitis. Clinical symptoms of the two diseases are similar and include tiredness, fever, headache, vomiting, hypersensitivity to light or noise, neck stiffness, or impaired consciousness and coma.

EPIDEMIOLOGY: *Food poisoning:* *C. perfringens* is one of the most common causes of food poisoning in United States and Canada. Contaminated meats contained in stews, soups and gravies are usually responsible for outbreaks in developed countries and cause about 250,000 cases of food-borne illness every year in USA. Deaths due to the disease are rare and occur mainly in elderly, debilitated, or individuals predisposed to the disease.

Gas Gangrene: *C. perfringens* is the most common cause of trauma associated gas gangrene with very high mortality rates.

Enteritis Necroticans: It was first recognized as a frequent cause of death among children in New Guinea in the 1960s. It has also been reported to occur among malnourished adults or people with chronic diseases such as diabetes in USA, United Kingdom, Germany and other developed nations.

HOST RANGE: Humans (mainly type A; type C rarely); animals such as dogs, pigs and goats also become infected with type A and type C.

INFECTIOUS DOSE: Unknown.

Food Poisoning: Ingestion of food containing 10^8 or more viable vegetative *C. perfringens* cells can result in food poisoning.

MODE OF TRANSMISSION: *Food Poisoning:* Food-borne illness acquired by ingestion of large number of *C. perfringens* vegetative cells present in the food. Food sources are usually cooked meat, vegetables, fish or poultry dishes which have been stored at ambient temperatures for a long time after cooking.

Enteritis Necroticans: Ingestion of contaminated pork meat.

Gas Gangrene/ Anaerobic Cellulitis: Infection can occur through contamination of wounds (fractures, bullet wounds) with dirt or any foreign material contaminated with *C. perfringens*.

INCUBATION PERIOD: *Food Poisoning:* 8-24 hours. *Gas Gangrene:* 1-4 days after the injury, but may also start within 10 hours.

COMMUNICABILITY: Not directly transmitted from person to person.

DISSEMINATION

RESERVOIR: Soil, water, air, feces of healthy and infected individuals, dust, vegetation, gastrointestinal tract of humans and animals, and variety of dehydrated and processed foods.

ZOONOSIS: *C. perfringens* type A food-borne disease and infections by *C. perfringens* type C can be transmitted from animals to humans.

VECTORS: None.

STABILITY AND VIABILITY

DRUG SUSCEPTIBILITY: Susceptible to many antibiotics such as penicillins, cephalosporins, clindamycin, metronidazole, rifapine, and tetracyclines.

DRUG RESISTANCE: Some strains resistant to clindamycin have been isolated.

SUSCEPTIBILITY TO DISINFECTANTS: Spores are resistant to most disinfectants and, when susceptible, they require longer contact time. *Clostridium* spores are resistant to ethyl and propyl alcohols, chlorine dioxide. Spores of clostridium species can be killed by high level disinfectants such as 2% aqueous glutaraldehyde within 3 hours, and 8% formaldehyde.

PHYSICAL INACTIVATION: Spores are highly resistant to both heat, and gamma-irradiation. Enterotoxin is heat labile and can be inactivated by heat treatment at 60°C for 5 minutes. Vegetative cells can be rapidly killed by dry heat at 160-170°C for 1-2 hours or moist heat at 121°C for 15 min-30 min.

SURVIVAL OUTSIDE HOST: Spores can survive in soil, crevices, food, decaying vegetation, marine sediments, internal cavities and in the anaerobic conditions inside the meat rolls, animal carcasses, feces, dehydrated and cooked food.

FIRST AID / MEDICAL

SURVEILLANCE: Diagnosis is based mainly on clinical symptoms.

Food-borne illness: Diagnosis consists of: 1) culture and characterization of the bacteria including Gram-stain; 2) PCR amplification of the enterotoxin (cpe) gene, as toxin production is associated with its presence; and 3) detection of cpe in feces through toxin assay, cell culture assay, ELISA (enzyme-linked immunosorbent assay) or RPLA (reverse-phase latex agglutination).

Enteritis Necroticans: Diagnosis consists of direct Gram-stain of specimens from symptomatic patients, and culture and characterization of the bacteria. Typing can be done using PCR (polymerase chain reaction) assay for the cpe and cpb genes, which code for alpha- and beta-toxins, respectively.

Gas gangrene/Anaerobic cellulitis: Diagnosis consists of direct Gram-stain smear from the wound of symptomatic patients for the presence of short chains of large, fat Gram-positive rods with blunt ends.

FIRST AID/TREATMENT: Food poisoning: Self-limiting disease. Therapy is mainly supportive; bowel resection may be required for very severe cases.

Gas Gangrene: Treatment mainly involves excision of all devitalized tissue in conjunction with antibiotic therapy with a combination of penicillin and clindamycin or tetracycline, which appear most effective based on animal models. *In vitro*, chloramphenicol, metronidazole, and several cephalosporins are active against *C. perfringens*. There have been a few reports of successful results using hyperbaric oxygenation in adjunctive therapy.

Anaerobic Cellulitis: Surgical debridement of the tissue and antibiotic therapy with penicillin or clindamycin. In case of drug resistance to clindamycin, second line antibacterial agents such as vancomycin can be used.

IMMUNIZATION: Vaccination against cpb toxin of *C. perfringens* type C which causes Enteritis Necroticans was reported to decrease the incidence of the disease in New Guinea.

PROPHYLAXIS: None.

LABORATORY HAZARDS

LABORATORY-ACQUIRED INFECTIONS: None have been reported to date.

SOURCE/SPECIMENS: Human feces, suspect food in a food-borne illness, blood, bowel luminal contents or tissue from the involved bowel in case of enteritis necroticans, wound exudates.

PRIMARY HAZARDS: Accidental ingestion of the enterotoxin, direct contact of open wounds/site of injury with the pathogen, accidental parenteral inoculation of the toxin.

SPECIAL HAZARDS: None.

EXPOSURE CONTROLS / PERSONAL PROTECTION

RISK GROUP CLASSIFICATION: Risk Group 2. This risk group applies to the species as a whole, and may not apply to every strain.

CONTAINMENT REQUIREMENTS: Containment Level 2 facilities, equipment, and operational practices for work involving infectious or potentially infectious materials, animals, or cultures. These containment requirements apply to the species as a whole, and may not apply to each strain within the species.

PROTECTIVE CLOTHING: Lab coat. Gloves when direct skin contact with infected materials or animals is unavoidable. Eye protection must be used where there is a known or potential risk of exposure to splashes.

OTHER PRECAUTIONS: All procedures that may produce aerosols, or involve high concentrations or large volumes should be conducted in a biological safety cabinet (BSC). The use of needles, syringes, and other sharp objects should be strictly limited. Additional precautions should be considered with work involving animals or large scale activities.

HANDLING AND STORAGE

SPILLS: Allow aerosols to settle, and wearing protective clothing, gently cover the spill with paper towels and apply an appropriate disinfectant, starting at the perimeter and then working towards the center. Allow sufficient contact time before clean up.

DISPOSAL: Decontaminate all wastes that contain or have come in contact with the infectious organism before disposing by autoclave, chemical disinfection, gamma irradiation, or incineration.

STORAGE: The infectious agent should be stored in leak-proof containers that are appropriately labeled.

REFERENCE

Pathogen Safety Data Sheet (PSDS) for *Clostridium perfringens* has been modified from the ones produced by the Public Health Agency of Canada as educational and informational resources for laboratory personnel working with infectious substances.

- 1) Picture from Wikipedia
- 2) Picture from www.foodsafetycounsel.com