CRYPTOSPORIDIUM -- BIOLOGY AND DIAGNOSIS

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INTRODUCTION

Cryptosporidium species, a minute coccidial protozoan, is a widely publicized causative agent of diarrheal infections in both immunocompromised\textsuperscript{1-6} and noncompromised hosts\textsuperscript{7-12}. Cryptosporidiosis is characterized by chronic intractable watery diarrhea and abdominal pain. Marked weight loss is often noted in the immunocompromised host especially in patients with acquired immunodeficiency syndrome (AIDS). Cryptosporidial cholecystitis\textsuperscript{12-14} and diffuse pneumonia\textsuperscript{15-17} have been reported as complications and disseminated cryptosporidiosis has been reported in an infant with congenital double immune deficiency\textsuperscript{16}. Other cases of cryptosporidiosis have been described in patients with immune disorders such as hypogammaglobulinemia\textsuperscript{18}, leukemia\textsuperscript{19}, and hemophilia\textsuperscript{20}. The recent awareness of this infectious agent originated from investigations of the current AIDS epidemic. A high incidence of individuals with AIDS suffer from intractable watery diarrhea which is refractory to all antimicrobial treatments\textsuperscript{21-22}. Even parenteral nutrition is unable to replenish the fluid loss resembling that seen in cholera. The search for a causative agent which was originally suspected to be a virus led to the discovery of numerous minute spherical double-walled structures (3-5um) lining the duodenal microvilli as seen by transmission electron microscopy. These structures actually represented the various endogenous stages of a parasite which was identified as a coccidial protozoan called Cryptosporidium species\textsuperscript{4,21-22}. A great deal has been learned and published within the last two years\textsuperscript{1-17,19-25} indicating that Cryptosporidium is found not only in the immunocompromised host but that it is ubiquitous and has caused travellers' diarrhea\textsuperscript{23-24}, outbreaks in day care centers\textsuperscript{25}, nosocomial infections (unpublished data) and community acquired infections in the general popula-
The mode of transmission is most likely oral-fecal with a high incidence of person to person spread\cite{9,11,28,57}, water/food borne transmission\cite{23}, and animal contact in special settings\cite{8}. Respiratory cryptosporidiosis due to inhalation of oocysts may be another mode of transmission\cite{15,17}. The prevalence of cryptosporidiosis varies from approximately 4%-10% in normal individuals\cite{28,8,11} to 28% in homosexuals and bisexuals, with 18% in AIDS and 10% in non-AIDS non-compromised individuals\cite{12}. The purpose of this chapter is to present briefly the biology (general characteristics, life cycle) and the diagnosis (clinical and microbiological) of Cryptosporidium species for those who are not familiar with this parasite.

### BIOLOGY

#### General Characteristics of Cryptosporidium

Cryptosporidium species was discovered and classified by Professor E.E. Tyzzer, head of the Department of Comparative Parasitology, Harvard School of Medicine in 1907 when he examined the gastric tumor of a house-mouse and was surprised to find numerous minute parasites (3-5μm) unknown to anyone at that time\cite{26}. By examining the intestinal sections with touch preparations stained with various stains he identified the parasite as a protozoan belonging to the Coccidia. The taxonomy of Cryptosporidium sp. as related to other members of the Coccidia is shown in Figure 1\cite{27}.

Cryptosporidium As a Single Species

From 1907 to 1981, Cryptosporidium has been found to be the causative agent of diarrhea in mammals and invertebrates, respiratory and intestinal infections in birds, and disseminated disease in immunocompromised arabian foals and juvenile monkeys\cite{1,28}. From 1976-1981, only 6 cases were reported in humans\cite{1,28}. Due to the lack of information of the complete life cycle, it was believed that there existed various species of Cryptosporidium depending on the host it affected\cite{27}. Levine recommended that of the 19 species named previously, only four could be considered valid (C. muris, Tyzzer, 1907, in mammals; C. meleagridis, Slavin, 1955, in birds; C. crotali, Triffit, 1925 in reptiles; and C. nasorum, Hoover, Hoerr, Carlton, Hinsman & Ferguson, 1981 in fish)\cite{29}.

In 1980, Tzipori et al conducted cross infections of Cryptosporidium among different mammals such as lamb, calf\cite{30}, and pig\cite{31}, and established the existence of a single species\cite{32}. This was confirmed by other investigators\cite{6,33}.