Section III.
Excreted Protozoa

Chapter

19

Balantidium and Balantidiasis

THREE PROTOZOAL INFECTIONS of the human intestinal tract are described in this book. Two of them, amebiasis due to *Entamoeba histolytica* (chapter 20) and giardiasis due to *Giardia lamblia* (chapter 21), are of major public health importance in many countries. The third, balantidiasis due to *Balantidium coli*, is relatively rare and is included for completeness. Two others about which little is known, isosporiasis due to *Isospora belli* and sarcocystiasis due to *Sarcocystis* species, are also rare as significant diseases of man and are omitted from this study. Also omitted are the nonpathogenic and rarely pathogenic amebae, and some flagellates of no public health importance.

Description of Pathogen and Disease

Balantidiasis is a little-studied infection, and therefore the following sections lack much of the detail that is found in other chapters.

Identification

Balantidiasis is an infection of the large intestine by the ciliate protozoon, *Balantidium coli*. In many infections (perhaps 80 percent) *Bal. coli* lives as a commensal in the lumen of the colon and causes no symptoms. Less frequently invasion of the colonic mucosa takes place, giving rise to a disease known as balantidial dysentery. Sufferers may present with diarrhea, sometimes bloody, and abdominal discomfort. The colonic lesions are grossly similar to those of amebic dysentery, but may reach the lymphatic vessels deep in the intestinal wall. The parasites may then penetrate to the regional lymph nodes, where a mild reaction occurs. Hematogenous spread to distant organs does not occur, in contrast with *Entamoeba histolytica*, but *Balantidium* may attack the terminal ileum and also cause acute appendicitis. Vaginitis and cystitis have also been observed. An inadequate diet may exacerbate the pathogenesis. Death may occur through the development of extensive ulceration and gangrenous changes, and may result from hemorrhage and dehydration. Reports of mortality range from 5 to 35 percent among clinical cases in the tropics. Treatment is by antibiotics, particularly tetracycline or ampicillin.

Diagnosis depends on demonstrating the characteristic *Bal. coli* trophozoites or cysts in the stools. The stool examined should ideally be fresh, but cysts and, under favorable conditions, trophozoites can be detected in fecal material preserved in 5 percent formol-saline.

Occurrence

This infection, although rare, is found worldwide, most commonly in the tropical and subtropical zones (Arean and Koppisch 1956). In areas where sanitation is poor and where pigs associate closely with man, prevalence of infection may exceed 20 percent. *Bal. coli* infects all ages, with the highest prevalence in endemic areas occurring among teenagers and adults.

Infectious agent

Bal. coli is the only parasitic ciliate of man. It is a flattened oval organism covered with cilia, with a gullet at the anterior end (figure 19-1). The trophozoite is 30–170 micrometers long by 25–120 micrometers broad. As in *Entamoeba* infection, cysts are found in the large intestine and passed in the formed stool. The cysts are ovoid or spherical and measure 45–65 micrometers in diameter. The trophozoite also may be an infective stage; it can live several days outside the host (Svensson 1955) and can withstand passage through the guinea pig stomach.

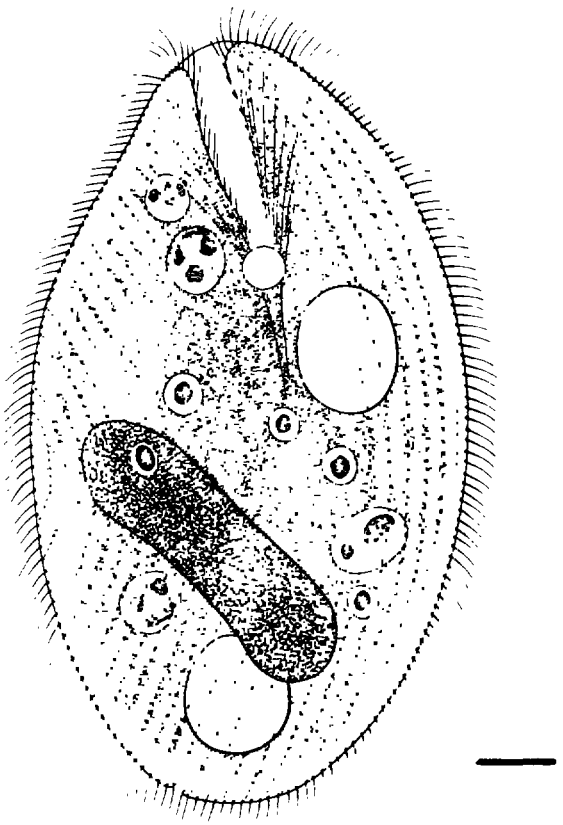

Figure 19-1. *Drawing of a trophozoite of* Balantidium coli. Scale bar = 10 micrometers. (From: Wenyon, C. M. (1926). *Protozoology*, vol. 2. London: Bailliere, Tindall and Cassel. Reproduced by courtesy of the publishers)

Reservoirs

Balantidiasis is a zoonosis. Many mammals are naturally infected, but it is the pig, and to a lesser extent the rat, that act as the main reservoirs for human infection (Awakian 1937; Ayeni 1973; Letonja and others 1975; Misra and others 1972). Prevalence among pigs is typically 50–100 percent, with 80 percent of pigs in the UK infected (Knight 1978). The majority of cases have a history of contact with pigs, but cases do occur in Moslem countries such as Iran. It is possible that only certain animal strains can infect man and then only under particular conditions of host susceptibility. Human strains will infect experimental animals including apes, pigs, cats, rodents, and guinea pigs (for instance, Westphal 1971), but it has not yet proved possible to infect man experimentally with cysts of human, simian, or porcine strains. *Bal. coli* has also been found in wild rats, and some human infections are thought to be derived from this source. The almost universal association of rats with domestic pigs may be relevant in this context. Sewer rats (*Rattus norvegicus*) are susceptible to infection with *Bal. coli* from man, pigs, or wild rats but are most susceptible to rat strains.

Transmission

It is assumed that the cyst of *Bal. coli* is the important resistant stage involved in transmission. Contamination of food, drinking water, and utensils by feces of pigs and, probably more important, by fecal material from persons carrying the infection, as well as direct fecal-oral contact appear to be the main modes of transmission. The same comments on transmission made for *Ent. histolytica* (chapter 20) apply here, though fewer cysts are produced per infected person in balantidiasis, and the proportion of infected persons producing cysts is also lower. Thus the incidence of *Bal. coli* is probably lower than that of *Ent. histolytica.* An early report suggests that the trophozoite is capable of passing the stomach barrier, so that acute cases, not producing cysts, could possibly be infective to people closely associated with them. However, other work has suggested that trophozoites are highly sensitive to pH values below 5. The median infective dose (ID_{50}) is not known, as man has not been successfully experimentally infected (Young 1950). It may well be comparable to that of *Entamoeba* and *Giardia*: 10–100 cysts (chapters 20 and 21).

Prepatent and incubation periods

Because man has not been infected experimentally and detailed epidemiological studies are lacking, the prepatent and incubation periods are not known.

Period of communicability

The disease is communicable for as long as the infection persists, although cysts are not often found in the stool. A 5-year history of chronic diarrhea, revealed as balantidial dysentery, has been described in one patient in Northern Ireland (Kennedy and Stewart 1957).

Resistance

Man appears to be a very resistant host. High prevalences of balantidiasis are found only in the exceptional circumstances of close contact with pigs. Attempts to infect man with cysts experimentally have so far failed. Disease may occur only when there is malnutrition or intercurrent infection.

Epidemiology

Balantidiasis is extremely rare in many countries, and its epidemiology is not well described. An endemic focus has been reported from the Seychelles (Nuti, de Comarmond and de Bac 1980).

Most epidemiological data come from Papua New Guinea and Irian Jaya (Indonesia). Balantidiasis in the highlands of both countries is common due to the practice of keeping, and often living with, large herds of domestic pigs (Bayliss Smith and Feachem 1977; Feachem 1973). Human prevalences in different communities in Papua New Guinea range from 2 to 29 percent and are twice as high in females as in males (Radford 1973). This is due to the fact that pigs sleep in the "women's houses" with the adult females and children. In the mountains of Irian Jaya, balantidiasis is especially prevalent where domestic or semidomestic pig populations are high and where altitude and harsh climate create a greater need for pigs to shelter in human houses at night (Couvée and Rijpstra 1961; van der Hoeven and Rijpstra 1957).

Following a typhoon in May 1971 there was an outbreak of balantidiasis involving 110 persons on Truk (Caroline Islands; Pacific Islands Trust Territory) described by Walzer and others (1973). The patients presented with gastrointestinal symptoms, and there was no serious morbidity. Both tetracycline and metronidazole were used in treatment, but there was no evidence that either was effective. The epidemic terminated spontaneously in early July. In 1970 there had been 410 cases of amebiasis and 4 of balantidiasis. Before the typhoon in 1971 there had been 1 case of balantidiasis. During the outbreak the youngest case was 2 months old and the oldest 70 years. Highest rates of attack were noted in the 1–4, 30–39, and 50–59 age groups, indicating that the source of transmission was something common to all age groups.

The 30,000 people of the Truk archipelago (119 square kilometers) lived in overcrowded conditions, often 15 persons per household. Privies discharging into the lagoon were shared by several families, and there was indiscrimate defecation by children around the houses. Pigs were kept by most householders, and *Bal. coli* was found in the fresh feces of four of six pigs examined. During the typhoon most of the houses in Truk were destroyed, together with their roof-water catchment systems, and this led to a reliance on wells and streams highly contaminated with pig feces. Cases of balantidiasis occurred almost simultaneously in widely separate areas, where the only common factors were the occurrence of the typhoon, the presence of pigs, and reliance on the roof-water catchment systems. Walzer and his colleagues considered that the balantidiasis outbreak occurred because the inhabitants used ground and surface water supplies, contaminated by pigs, after their relatively clean sources of water were destroyed by the typhoon.

Control Measures

Balantidiasis is not a major public health problem, and its control has not been studied. All the comments made about amebiasis and giardiasis control (chapters 20 and 21) may apply to balantidiasis control.

Individual

Mass chemotherapy has not been tried, and there is no vaccine. Individual protection may be achieved by personal and domestic cleanliness and by care in the choice and preparation of drinking water and vegetables. Pig farmers may be especially at risk.

Environmental

A single study in Venezuela showed that preschool children in houses with inside water and washing facilities had a balantidiasis prevalence of 4 percent, whereas those in other houses had a prevalence of 9 percent (van Zijl 1966). Confounding socioeconomic variables were not controlled.

The importance of hygienic excreta disposal to prevent transmission of the cysts directly to other individuals is accepted. Equally important is the hygienic disposal of porcine excreta, and its separation from human food. Personal and domestic cleanliness, encouraged by adequate water supplies and strenuous hygiene education, are essential. Where cultural and farming norms cause the cohabitation of people and pigs, as in some parts of Papua New Guinea, the control of balantidiasis may be impossible.

Occurrence and Survival in the Environment

There is no information on *Bal. coli* cysts in the environment. It may be assumed that in most moist environments their survival is dependent on time and temperature and is similar to that of *Ent. histolytica* cysts (see figure 20-2). They are rapidly killed by desiccation.

Inactivation by Sewage Treatment Processes

No specific information has been reported. The cysts of *Bal. coli* are appreciably larger than those of *Ent. histolytica* and are likely to settle more rapidly (no information has been found on density). Otherwise it may be assumed that *Bal. coli* cysts in sewage treatment respond like *Ent. histolytica* cysts (chapter 20).

Inactivation by Night Soil and Sludge Treatment Processes

No specific information has been reported. It may be assumed that *Bal. coli* cysts in night soil and sludge treatment processes respond in the same way as *Ent. histolytica* cysts (chapter 20).

Literature Cited

Arean, V. M. and Koppisch, E. (1956). Balantidiasis. A review and report of cases. *American Journal of Pathology*, **32**, 1089–1115.

Awakian, A. (1937). Studies on the intestinal protozoa of rats. II. Rats as carriers of *Balantidium*. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **31**, 93–98.

Ayeni, A. O. (1973). Internal parasites of livestock in the Western State of Nigeria. I. Helminth parasites of pigs. *Nigerian Agricultural Journal*, **10**, 43–45.

Bayliss Smith, T. P. and Feachem, R. G. (1977). *Subsistence and Survival: Rural Ecology in the Pacific*. London: Academic Press.

Couvée, L. M. J. and Rijpstra, A. C. (1961). The prevalence of *Balantidium coli* in the central highlands of western New Guinea. *Tropical and Geographical Medicine*, **13**, 284–286.

Feachem, R. G. (1973). The Raiapu Enga pig herd. *Mankind*. **9**, 25–31.

Kennedy, C. C. and Stewart, R. C. (1957). Balantidial dysentery: a human case in Northern Ireland. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **51**, 549–558.

Knight, R. (1978). Giardiasis, isosporiasis and balantidiasis. *Clinics in Gastroenterology*, **7**, 31–47.

Letonja, T., Henriquez, A., Reyes, G. and Zapata, L. (1975). Prevalence of *Balantidium coli* infections in swine from Santiago, Chile. *Boletín Chileno de Parasitología*, **30**, 88–89.

Misra, S. C., Das, D. N., Patnaik, K. C. and Mohapatra, H. C. (1972). Incidence of gastrointestinal parasites in pigs with evaluation of an effective technique for the recovery of their ova or cysts in the faeces. *Indian Veterinary Journal*, **49**, 140–145.

Nuti, M., de Comarmond, C. and de Bac, C. (1980). An endemic focus of balantidiasis in the Seychelles islands. Abstract 18. *Abstracts of the 10th International Congress on Tropical Medicine and Malaria*. Manila, Philippines.

Radford, A. J. (1973). Balantidiasis in Papua New Guinea. *Medical Journal of Australia*, **60**, 238–241.

Svensson, R. (1955). On the resistance to heating and cooling of *Balantidium coli* in culture, and some observations regarding conjugation. *Experimental Parasitology*, **4**, 502–525.

van der Hoeven, J. A. and Rijpstra, A. C. (1957). Intestinal parasites in the central mountain district of Netherlands New Guinea. An important focus of *Balantidium coli*. *Documenta de Medicina Geographica et Tropica*, **9**, 225–228.

van Zijl, W. J. (1966). Studies on diarrhoeal diseases in seven countries by the WHO Diarrhoeal Diseases Advisory Team. *Bulletin of the World Health Organization*, **35**, 249–261.

Walzer, P. D., Judson, F. N., Murphy, K. B., Healy, G. R., English, D. K. and Schultz, M. G. (1973). Balantidiasis outbreak in Truk. *American Journal of Tropical Medicine and Hygiene*, **22**, 33–41.

Westphal, A. (1971). Experimental infection of mice and guinea pigs with *Balantidium coli*. *Zeitschrift für Tropenmedizin und Parasitologie*. **22**, 138–148.

Young, M. D. (1950). Attempts to transmit human *Balantidium coli*. *American Journal of Tropical Medicine*, **30**, 71–72.