BALANTIDIUM COLI INFECTION WITH REPORT OF A CASE IN A CHILD*

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There appeared in my service in the outpatient department of the Touro Infirmary in New Orleans an interesting and unusual case of dysentery which because of the age of the patient, the source of the infection and the character of the organism found deserves recording if for no other reason than as a reminder of another possible etiologic factor in the production of frequent stools. The infrequency of many diseases in childhood undoubtedly is in great part due to lessened exposure incident to age. This explanation advanced several years ago in the instance of amebiasis in children may also be suggested for the rare infection in childhood of this unusual offender in man.

While the case was not observed for as long a time as would have been preferred, nevertheless for the foregoing reasons and because of the easy means of its recognition, this case of *Balantidium coli* in a child is reported.

REPORT OF CASE

History.—A colored boy 5 years of age was brought to the outpatient children's department at Touro Infirmary by his mother who stated that the child had been having a diarrhea for nearly a year, but that recently she noticed blood in his bowel movements. During the period from the first attack of diarrhea to the present time there had been intervals when the child was apparently well and had no bowel trouble. With this last attack, however, blood had appeared and he seemed sicker than ever. The attacks were progressive in severity, each one being worse than the one preceding. He strained when his bowels moved, complained of pain in his stomach, had no appetite, and had been losing weight. He had been accustomed to help "round up" the pigs in the pen every day and frequently would eat some food which he would hold in his hand while helping with the pigs. It was his habit also to go into the pen at times when he ate his food.

The family history was negative, except that the father, who tended the pigs, had a diarrhea a short time previously, the character of which could not be ascertained.

Past History.—The patient was a full term child. He had never been ill before the diarrhea, and had always been nourished as other children of his race.

Physical Examination.—This showed a patient poorly nourished but fairly well developed. His skin was dry, as was his tongue and mouth. There was a catarrhal stomatitis. His eyes were sunken. His lungs, heart, liver, spleen and abdomen were negative except for some tenderness over the lower abdomen. The nervous system was also negative.

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A rectal tube was passed and some bloody mucus obtained, which was immediately examined and revealed the presence of *Balantidium coli.*

As there were no beds available at Touro Infirmary he was referred to my service at the Charity Hospital, but unfortunately he never appeared at the hospital and was lost sight of.

Description of Organism.—The organisms seen in this case belonged to the infusoria variety of the protozoa and are known as *Balantidium coli.* They were oval-shaped, more pointed and tapering at one end and rounded at the other, and measured from 0.07 to 0.1 mm. in length by 0.05 to 0.07 mm. in breadth. The mouth was funnel-shaped and situated on the ventral side of the organism a little below the anterior or pointed pole. A thick layer of long cilia was found around the peristome, which continued actively a circulatory motion, and by the use of which the organism grasped its food: various cells, bacteria, and blood cells. The funnel-shaped mouth extended backward and downward and communicated with the endosarc.

The endosarc consisted of granular matter both fine and coarse and highly refractile, inclosed in a thin and very transparent sheath, which was a continuation of the gullet above and which ended at the anus situated at the posterior or more rounded pole. A kidney-shaped nucleus, which changed its position with the motion of the granular matter, was found in the endosarc usually below and to one side of the peristome. Vacuoles were seen in the endosarc numbering from one to six, usually two, and were apparently contractile. These vacuoles according to Stein[1] are connected by lacunae, which probably explains the large single vacuole sometimes seen which occupies the whole lower third of the parasite.

A thick cuticle longitudinally striated inclosed the endosarc and was separated from it by a narrow rim of homogeneous protoplasm (the ectosarc). These striations, undoubtedly muscular structures, extended from the peristome on the ventral surface and from a corresponding level on the dorsal surface to the anus of the posterior pole.

Cilia extending throughout the entire length of these striations controlled the movements of the parasite.

By means of these cilia and muscular bands the parasite was able to move with tremendous rapidity and comparative ease through fields containing large particles of matter. The parasite was capable of changing its shape and direction with great facility by contracting the muscular bands.

At times the organisms appeared quite round.

Encysted forms of the parasite have been described by Leuckart[2] and Stein,[1] in which the organism becomes rounded, loses its cilia, the endosarc contracts and contains fat globules, the nucleus becomes obscured, and it is surrounded by a thick capsule.

From the careful observations of Bel and Couret[3] through the entire cycle the method of reproduction of these infusoria is by budding conjugation and binary fission. Many other methods of conjugation and reproduction have been described by Wising,[4] Woit,[5]

1. Stein, F.: Bohmisch. Genzell der Wissenchaften, 1860, p. 165; Amtl. Ber. d. Karlsbad, Naturforch., 1862.
2. Leuckart: Die menschlichen Parasiten, 1863, p. 1; Parasiten des Menschen, 1879, p. 3.
3. Bel and Couret: Balantidium Coli Infection in Man, Jour. Infect. Dis., 1910, **7,** 609.
4. Wising, P. J.: Nord. med. Arch., 1871, **3,** No. 3, Stockholm; Ibid., Svensk. Läk. Sällsk. Handl., 1885, p. 48, Stockholm.
5. Woit, O.: Deutsch. Arch. f. klin. Med., 1897, **60,** 363.

Gurvich,[6] Bushuyeff,[7] Lavrovskaya,[8] Zhegaloff[9] and Daflein.[10] The observations of Bel and Couret[3] with regard to reproduction conform to those of Ekecrantz,[11] Wising,[4] Leuckart,[2] Strong[12] and others.

Conflicting results have been obtained from animal experimentation by Wising,[4] Lavrovskaya,[8] Strong,[12] Zhegaloff,[9] Rapchevski,[13] Chigayeff,[14] Vlayeff,[15] Cassagrandi and Barbagello[16] and Chichulin[17] by injecting feces containing balantidia in cats, dogs, rabbits, pigs and monkeys.

Grassi and Calandruccio[18] produced no results on themselves after injecting balantidia from the hog.

Leuckart[19] describes these organisms as being much less sensible to the influence of water and cold than other nomads, and as preserving their viability and motility for long periods in water at ordinary temperature. Klein[20] recognized an organism which he believed to be *Balantidium coli* which he secured from sewage and which after being bottled in sewage lived and were yet motile in thirteen weeks. On the other hand, Malmsten[21] concluded that the parasite is short lived, since it died shortly after removal from the intestine, and Zhegaloff[9] was of the same opinion. From the various statements made by observers it may be said that the length of time the organism may live is variable. Attempts to prolong their lives in feces by Bel and Couret[3] were unsuccessful at various temperatures, as were also their attempts at the cultivation of the organism. Other observers have met with the same negative results, and Strong[12] states that the parasite has not been grown or isolated in pure cultures.

Balantidium coli were probably first observed by Lieuwenholk[22]

6. Gurvich, M. J.: Russk. Arch. Patol., I. Bakteriol., 1896, **2,** 804.
7. Bushuyeff, V. F.: Voyenno-medic. Jour., 1897, p. 188, Med. Spec. Part, p. 167.
8. Lavrovskaya, Y.: Bolnitch Gaz. Botkina, 1891, No. 11, p. 304, St. Petersburg.
9. Zhegaloff, J. P.: Klin. Jour. Mosk., 1899, **1,** 44.
10. Doflein, F.: Die Protozen als Parasit. u. Krankheitserreger, Jena, 1901.
11. Ekecrantz, W.: Nord. Med. Arch., 1869, p. 1, Stockholm.
12. Strong, R. P.: Dept. of Interior, Bureau of Govt. Lab. Biol. Survey, No. 26, December, 1904.
13. Rapchevski, I. F.: Vratch, St. Petersburg, 1880, p. 505; Med. Vestulk, St. Petersburg, 1882, **21,** 361, 377 and 393.
14. Chigayeff, N. F.: Vratch, St. Petersburg, 1898, **19,** 1441.
15. Vlayeff: Vratch, St. Petersburg, 1898, **19,** 140.
16. Cassagrandi and Barbagello (Quoted by Strong, Footnote 12).
17. Chichulin, G. N.: Voyenno Med., 1900, **78,** Med. Spec. Part, p. 3059, St. Petersburg.
18. Grassi and Calandruccio: Acc. d. R. Acad. d. Linc., Roma, 1888, 285, series 4, vol. 4, p. 700.
19. Leuckart: Brit. Med. Jour., Dec. 19, 1896, p. 1797.
20. Klein, E.: Brit. Med. Jour., 1896, **2,** p. 1852.
21. Malmsten, P. H.: Allg. med. Centr. Ztg., Berl., 1858, **27,** 81.
22. Lieuwenholk: Quoted by Strong, Bull. Johns Hopkins Hosp., 1901, **12,** 31.

in his own stools in 1857. In 1857 Malmsten and Loven[23] first described them as *Paramecium coli,* and five years later (1862) Malmsten[24] reported two cases. Stein,[1] in 1862, proposed the name of *Balantidium coli.*

In 1891 Mitter[25] was able to collect only twenty-eight cases. Strong,[12] in 1901, only 117 cases, including reports from Africa, Cochin China, Cuba, Finland, Germany, Italy, North and South America, Philippines, Russia, Sunda Islands and Sweden.

In the United States probably the first case to be reported was in Iowa by Mitter[25] in 1891. Since then cases have been reported by Bel and Couret,[3] 1 in Louisiana; Gray,[26] 3 in Arkansas; Deaderick,[27] 1 in Eastern Arkansas; Sistrunk,[28] 1 in Minnesota; Rockefeller Sanitary Commission,[29] 2 in North Carolina and 1 in Mississippi; Jennings,[30] 1 in New York; Bowman,[31] 2 in the Philippine Islands; and Young and Walker,[32] 1 case in Oklahoma.

In all, the literature contains considerably less than 150 reported cases of this infection in man. Men have been infected twice as frequently as women, and in the cases reported all have been adults with the exception of two cases in children.

The habitat of this infusorium in the human being is in the large intestine, but they have been found in the appendix (Malmsten[21]).

Leuckart[33] was the first to show the pig to be the normal host of the *Balantidium coli.* He suggested that the possible way infection occurred was by the entrance of the freshly voided parasites into the alimentary tract of the human being. He also suggested ingestion of the organism in the encysted state as a probable method of infection.

Deaderick[27] says that besides the domestic pig, certain species of monkeys serve as hosts for the balantidium.

The observation of Klein,[20] who found an organism he believed to be the *Balantidium coli* in the sewage of London, and also in the

23. Malmsten, P. H., and Loven: Infusurier säsom intestinaljar homemeskan, Hygeia, Stockholm, 1857, **19,** 491; Virchows Arch. f. path. Anat., 1857, **12,** 302.

24. Malmsten, P. H.: Quoted by Strong and Musgrove, Bull. Johns Hopkins Hosp., 1901, **12,** 31.

25. Mitter, J. J.: Beitrag z. Kenntness zur Balantidium Coli in Menschlichen Darmkanale, Kiel, 1891.

26. Gray, D. A.: St. Louis Med. Rev., April 27, 1907.

27. Deaderick: Endemic Diseases of Southern States, 1916.

28. Sistrunk, W. E.: Intestinal Parasites Found in Individuals Residing in the Northwest, Jour. Am. Med. Assn., 1911, **57,** 1507.

29. Rockefeller Sanitary Commission Reports, 1911, 1912 and 1913.

30. Jennings: New York State Jour. Med., 1912, **12,** 179.

31. Bowman, F. S.: Studies in Balantidium Infection, Med. Rec., New York, April 22, 1911.

32. Young, A. O., and Walker, O. J.: Balantidium Coli Infection in Oklahoma, Jour. Am. Med. Assn., 1918, **70,** 507.

33. Leuckart: Weighman's Arch., 1861, **1,** 80, Plate V, Fig. A, B; Die menschlichen Parasiten, 1863, p. 146; Fig. 21, p. 744.

drinking water of the same city as delivered to the consumer, suggests the entrance of the organism through drinking water as a means of infection.

It is of interest to note that in about 25 per cent. of the cases reported infected with *Balantidium coli* there has been either direct contact with swine or the infection has followed ingestion of food products from pork.

An entire family infected with *Balantidium coli* after eating sausages made from a hog which had harbored the organism is reported by Chichulin.[34]

Henschen[35] especially emphasizes the pathologic importance of the parasite, while other authors are inclined to believe the presence of the parasite to be an accidental or unimportant complication.

In 1900 Opie,[36] in his article on protozoa, concludes "that *Balantidium coli* is apparently an accidental parasite which finds favorable conditions for growth in the diseased intestine, and that it is improbable that the organism is the etiologic factor in the production of the diarrhea with which it is associated."

McFarland[37] holds that the organism is not certainly parasitic, but perhaps merely commensal; that is, it inhabits the body of its host, but without any effect on the host either detrimental or advantageous.

Malmsten[21] and Doflein[10] believe the organism to be harmless, but Strong,[12] Brooks,[38] Solowjew,[39] Bel and Couret[3] and others believe the balantidium is an important etiologic factor in the production of the catarrhal and ulcerative lesions of the large intestine in the infection associated with its presence.

Certainly the cases of Strong and Musgrave[40] and Bel and Couret,[3] which have been so carefully and minutely studied, are conclusive evidence of the pathogenicity of the organism. To quote their conclusions:

Strong and Musgrave:[42] We cannot regard this parasite as a harmless one for we could not explain the persistent diarrhea of our patient without regarding it as the exciting cause, nor were we from the lesions found at necropsy enabled to explain his death in any other way.

Bel and Couret:[3] Finally, from the definite and constant microscopic findings and negative blood and cultural results for other intestinal invaders, the logical conclusion seems to be that *Balantidium coli* is not a harmless commensal, as some suppose, but an organism able to invade the human tissues and cause a serious disease; death may follow through compression of the intestinal glands by a hyperplasia of interglandular tissue produced by the parasites and through glandular necrosis and absorption of toxins from any terminal bacterial invasion.

34. Chichulin, G. N.: Loc. cit., Footnote 17.
35. Henschen: Quoted by Strong and Musgrave, Footnote 42.
36. Opie: Twentieth Century Practice of Medicine, 1900, **19.**
37. McFarland: Quoted by Jennings, Footnote 30.
38. Brooks, H.: New York Univ. Bull. Med. Sc., January, 1902.
39. Solowjew, N.: Centralbl. f. Bact., Ref., 1901, **29,** 821 and 849.
40. Strong and Musgrave: Bull. Johns Hopkins Hosp., 1901, **12.** 32.

The infectious character of the *Balantidium coli* is seen in the observations of Brooks[40] on a fatal dysentery among the apes in the New York Zoological Garden, and the pathology of the infection in man is clearly shown by the necropsies and studies of Strong and Musgrave,[42] Solowjew,[41] and Bel and Couret.[3]

The organisms invade all the coats and blood vessels and lymph channels of the large intestine and the neighboring lymph glands, and produce a hyperplasia and cell infiltration either mechanically or through the liberation of cytolytic ferments. Ulcers which are small and shallow and mostly limited to the mucosa are found which are probably due to the terminal invading bacteria, the balantidium coli primarily producing avenues of entrance, as they are absent from the walls of the ulcers; some, however, penetrate the muscularis mucosa. The organisms produce a subacute or chronic inflammation of the interglandular tissues and submucosa.

The presence of the organisms in the blood vessels and lymph channels argues for the possibility of carrying infection to the liver and lung through these routes (Couret and Bel[3]).

The patients suffering with this infection may have digestive troubles, but usually have a diarrhea or dysentery. The stools are liquid and may contain undigested food. There is usually mucus or blood, the stools resembling those seen in amebic dysentery. These may be from a few to many in the course of the twenty-four hours. Tormina and tenesmus are frequent, the latter particularly if the lesions are situated near the anus.

The symptoms may subside for a period, to begin again. In those cases of prolonged duration anemia may be found and there is great loss of weight. At times there is edema. In some cases severe and pernicious anemia has been suspected. The course of the disease is usually progressive.

Examination of the blood usually shows slight variations from the normal and there may or may not be an eosinophilia.

The skin is dry, the temperature is normal or there may be a rise up to 99 F. Hebetude is present to a greater or lesser degree, the tongue is dry, at times a stomatitis may be present. The lymph nodes are occasionally enlarged. Emaciation is a common symptom.

The urine shows nothing of interest.

Proctoscopic examination usually reveals the rectum and lower colon lined with thick, bloody mucus covering the shallow ulcers which readily bleed.

The diagnosis is promptly made by the examination of the stools or by introducing the rectal tube and examining some of the bloody stained mucus, when the characteristic organisms are easily discern-

able. By examining the fresh specimen while it is still warm the parasite is found to be very active, but it becomes more sluggish as its surroundings become colder.

The duration of the diarrhea in patients known to be infected with the parasites has been as long as fifteen years.

All the reported cases, with two exceptions besides this one, have been in adults. The age of this patient is next to the youngest recorded, the other two being 4 years and 5⅓ years, respectively.

The prognosis depends on the ability to rid the host of the balantidia. Many cases are shown wherein the relative decrease in the numbers of the parasites is coincident with a corresponding improvement of the patient.

Remembering the pathology of the disease, with its possible complications in the liver and lungs, it may be said that the earlier the diagnosis and the more thorough the treatment the better the prognosis. The mortality has been given as high as 30 per cent. by Strong.

From the information available the prophylaxis should be directed toward the care and hygiene of those who are in close contact with the care of swine and the manufacture of pork products, and the thorough cooking of the pork products before ingestion. If to this is added a safe water supply, prophylactic measures against this infection will be as complete as our present knowledge will warrant.

Many drugs have been employed in the treatment of this infection, mostly by colonic flushing and by enema. Quinin, tannic acid, silver nitrate, iodin, acetic acid, salicylic acid and boric acid, methylene blue, thymol in olive oil followed by castor oil, have all been employed. By mouth arsenic and thymol have been used.

There is as yet no known specific in the treatment of this disease, but because of the resemblance of this infection to that of amebic dysentery: (1) in the invasion and location of the organisms in the tissues; (2) in the histologic pathology; and (3) in its clinical manifestations, it would seem that ipecac or its alkaloid, emetin, should be employed, as it is hardly to be expected that local flushings will be of any avail after the infection is established.

If in reporting this case I may only have stimulated interest as to the possibility of this parasite being a cause of frequent stools and placed the physician on guard for the recognition of this infection, which has been shown to exist not only in tropical and subtropical climates, but in the colder climates as well, where the symptoms are less severe, I will feel that the purpose of this paper will have been subserved.

NOTE.—Since writing this paper another case has come to my knowledge in which emetin was employed in its treatment, and, I am told, with spectacular results.