

**BALANTIDIASIS**

**by**

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INTRODUCTION

A series of 74 cases of Balantidiasis is described with the result of treatment and a six-month follow-up.

Balantidium Coli was first described by Malmsten in Stockholm, in 1857. In 1861 Leuckhart discovered it in swine, and gave it the name Paramecium Coli. Stein especially described the parasite in 1863, and transferred it to the genus Balantidium.

Balantidiasis is a rare disease. Little<sup>1</sup> states that fewer than 250 cases have been reported in the medical literature. Young<sup>2</sup> records only a total of 43 cases in the United States of America. Only two cases have been reported in Great Britain, these by McKenzie and Bean<sup>3</sup>, and Robertson<sup>4</sup>.

The ciliate is a common inhabitant of the intestine of pigs, and Craig and Faust<sup>5</sup> state that over 25% of recorded cases give a history of contact with pigs. Walker<sup>6</sup> considers the pig the chief source of infection in the Philippines. Halawani and El Kordy<sup>7</sup> believe that the rarity of balantidial infection in Egypt may be due to the fact that the great majority of Egyptians are Mohammedans who are not allowed to eat the meat of pigs, or rear them. Ostroumov<sup>8</sup> concludes that pigs have no part in the epidemiology of human balantidiasis.

McDonald<sup>9</sup> considers that two species of Balantidium - Coli and Suis - normally infect the pig. The latter is smaller and does not infect man. Hsiung<sup>10</sup> supports this contention, but Hegner<sup>11</sup> considers it is not definite that two separate species exist. Ostroumov<sup>8</sup> states he is convinced that the human and porcine Balantidium are two separate

species.

Balantidiasis was first noted in Abadan in 1929, (Annual Medical Report of the Anglo-Iranian Oil Co. Ltd.) and has been observed continuously since. Little or no attention has been paid to the condition however, until the collection of this series. The writer held an appointment for five years as medical officer to the Anglo-Iranian Oil Co. Ltd., for part of that time being in charge of the Company's Isolation Hospital. The cases to be described were collected by him during the period April 1st, 1948 to December 31st, 1948.

A.

## GENERAL DESCRIPTION

Synonyms. Balantidial Dysentery.

Distribution. Cases have been reported from temperate, sub-tropical and tropical countries, the disease having a world-wide distribution.

Etiology. The causal agent is the Balantidium Coli, a pathogenic ciliate commonly found in the intestine of pigs, and occasionally in man. The organisms have also been found in the intestines of orang-outangs and monkeys<sup>12</sup> and rats<sup>13</sup>.

Pathology. Strong<sup>14</sup> studied cases in the Philippines, and gave the first description of the pathological histology. He found that the ciliates invade the mucosa, muscularis, and submucosa, causing round cell infiltration, increase in eosinophils, and accumulations of polymorphs. Later they undermine the mucosa and eventually produce ulcers. According to Walker<sup>6</sup>, in the early lesion there is vascular dilatation with minute haemorrhages, round cell infiltration, and eosinophilia. He states that the Balantidium penetrates the mucosa in a mechanical manner, forcing its way deeply between the epithelial cells.

The lesions produced differ little from amoebic ulceration. The severity of the lesions varies from catarrhal congestion and diphtheritic patches to extensive ulceration. The balantidium penetrates the mucosa, later undermining it, and eventually producing ulcers, which are sometimes haemorrhagic. The lesions are discrete, and the intervening mucosa normal, although the ulceration may be wide-spread. Secondary infection follows rapidly on the invasion by the ciliates, with infiltration of inflammatory cells. An inflammatory exudate is present in the stools. Strong<sup>14</sup> states that in 40 necropsies,

ulceration of the large bowel was found in 36.

On section of lesions in fatal cases, Strong<sup>14</sup> demonstrated the Balantidium in the exudates on the surface of the bowel, congregated in large numbers in the follicles and embedded in the tissues forming the base of the ulcerations, including the submucosa and muscular coats, and even in the lumen of blood vessels and lymphatics. Manson-Bahr<sup>15</sup> cites Martini and Walker as having found the Balantidium in mesenteric glands. Abscess of the liver due to Balantidium Coli has not been reported. Koppisch and Wilking<sup>16</sup> recently reported in great detail three acute fatal cases and one chronic case who died of tuberculosis. Their findings confirm those of the earlier workers. Two of the acute cases had perforations of the ileum, which is very rare. All the acute cases had various concurrent helminthic infestations, and the authors suggest that Balantidium Coli only becomes virulent when the patient's general condition is lowered by concurrent disease.

Clinical Characteristics. The disease is generally chronic, and may be present for many years. Asymptomatic cases occur however, and at the other extreme, fulminating cases occur with an early fatal issue. In the usual case, there is diarrhoea or loose stools, sometimes with blood and mucus. Colicky abdominal pain is frequently present. In the fulminating cases, the diarrhoea is severe.

Diagnosis. The diagnosis is made on demonstration of the ciliate or the cysts in the stools. Mobile trophozoites will be found when the stools are liquid, and usually the encysted form in solid faeces.

Morphology. The Balantidium Coli is oval or egg-shaped with an average size of 50u by 70u. The body is clothed with a thick covering

of cilia arranged in longitudinal rows.

The nucleus is represented by a large kidney-shaped macronucleus, and a small rounded micronucleus closely approximated. The protoplasm contains two contractile, and a number of food vacuoles. There is a funnel shaped cytostome at the anterior and through which the Balantidium feeds. Body wastes are discharged through the anal opening, the cytopyge. The animal swims with a forward rotary motion.

Reproduction occurs asexually by transverse fission, the macronucleus dividing by simple constriction, and the micronucleus by mitosis.

Conjugation takes place by the exchange of certain nuclear elements, and when once this has been effected, the conjugants once more separate.

The cysts are ovoid, 50 - 60u in diameter, and are protected by a transparent double wall. The enclosed balantidium loses its cilia, and sometimes two individuals are found in the same cyst.

The ciliate is easily cultivated, partial anaerobic conditions being best. Any of the media suitable for entamoeba histolytica are satisfactory. It has not been grown on bacteria-free media.

Prognosis. Strong<sup>14</sup> gives a mortality rate of 29% in 111 severe cases. Walker<sup>6</sup> gives 7% in 57 mild cases. In the series to be described there were no fatalities.

Treatment. Many various forms of treatment have been advocated by different writers, and there is no universally accepted therapeutic specific.

Cort<sup>17</sup> reports success in twelve cases treated with a

retention enema of 15 cc. oil of chenopodium in 150 cc. olive oil. All cases remained negative on a follow-up of 9 - 28 months.

Banik<sup>18</sup> reports one case cured by retention enemata of Yatren, 8 oz. of a 2.5% solution daily for 3 days. In this case six daily injections of emetine gr.  $\frac{1}{2}$ , and thymol gr. 16 had failed.

Cure of a case by three retention enemata of 2 pints of Loeffler's methylene-blue is reported by McKenzie and Bean<sup>3</sup>.

Robertson's<sup>4</sup> case was treated with enemata of methylene-blue, sulphaguanidine, and artificial pyrexia. The stools remained positive. Stronger enemata of methylene-blue were then given and the stools did become negative. However, the following day the patient died of cardio-vascular degeneration, so it was not decided whether the methylene-blue had been curative or not.

Liu<sup>19</sup> reports a case in a child cured by the administration of 'Spirocid' - an arsenical preparation - .05 gm. twice daily for 3 days.

Diaz Atilas<sup>20</sup> reports cure of two cases by administration of stevarsol in increasing dosage, over a week.

De Lanney and Beahm<sup>21</sup> report the failure of oil of chenopodium enema, and carborsone, in the treatment of a case. Cure was effected by diodoquin 2.5 gm. daily for 20 days.

Young and Burrows<sup>22</sup> with a follow-up period of a few months to four years, report seven cases cured with carbarsone in courses totalling 5 or 10 gm. over a 10 day period.

Tsuchiya and Kenomere<sup>23</sup> report one case cured with carbarsone .25 gm. twice daily for 10 days. The case was followed up for two months.

Shun-Shin<sup>24</sup> recommends mercury biniodide by intramuscular injection. 9 cases are reported cured by injections of  $1/24 - \frac{1}{8}$  gr. depending on the age of the patient, and a total of 2 - 11 injections. He reports failure of mepocrine in 1 case.

Pramanik<sup>25</sup> also reports success with mercury biniodide, in one case.

B. SITE, LOCALITY, AND SOCIAL CIRCUMSTANCES OF THE OUTBREAK.

The outbreak described, occurred among the population of Abadan, an oil refinery town on the island of Abadan, S. Persia. The island is situated in the estuary of the Shatt-el-Arab River, at the head of the Persian gulf, and is some 30 miles long and 5 miles wide at its broadest part. It is almost entirely flat desert, except for small areas under cultivation. The temperature in winter seldom falls below freezing point, and the summer shade temperature averages 110 - 118°F, with usually low humidity. The winter rainfall is about 15 inches. Rain does not fall during the summer.

The population of the town consists of about 200,000 Persians, 2,000 Indians and Pakistanis, and 2,500 British. About 100,000 of the Persians are either employed in the refinery operated by the Anglo-Iranian Oil Co. Ltd., or are dependents of employees.

No case in this series occurred among Indian, Pakistan, or British employees. With two or three exceptions, all cases occurred among labour and artisan class employees, that is, among the lower social grades. All were Mohammedans, and therefore never have contact with pigs, nor do they eat pork.

C. LOCAL CONDITIONS FAVOURING THE INFECTION.

Conditions existing among this class of person are ideal for the transmission of any infection. Many live in mud or mud-brick houses under extreme conditions of filth and overcrowding. A man and his entire family, along with various domestic animals and birds, frequently inhabit one tiny room, which will often have not even one window. In the majority of houses not even the simplest sanitary arrangements exist. Conditions in houses provided by the company are somewhat better, but the natural habits of low class Persians tend to nullify any improved housing conditions.

The ordinary native has not even the most elementary knowledge of hygiene. Although clean, safe drinking water is provided by the company, he will just as soon drink from the polluted river - in fact he probably prefers the latter. He will urinate or defaecate whenever necessary, irrespective of his surroundings.

Alongside the native bazaar, is a large creek, in tidal communication with the river. This is used by many Persians as a lavatory, and bath and swimming pool in the summer months, and is also the place where many native women do their washing. This creek is never used by Indian, Pakistan, or British employees.

Food in the local shops is exposed to swarms of flies, and much of it is consumed unwashed and uncooked. Conditions locally therefore greatly favour the transmission from person to person, of any of the dysenteric diseases. In addition, there is always quite a large number of peasants arriving in Abadan from the hills and

villages of the hinterland. They come in search of employment in the refinery. The majority of these are penniless and half-starved, and on arrival in Abadan, live in a hutment under conditions of inconceivable squalor. The hutment is known as Khaghazabad - Town of paper - as all the huts are constructed of cardboard boxes, cement bags, etc. Many epidemics which have occurred in Abadan, have originated from this colony.

D.

## PREVENTIVE MEASURES ALREADY IN FORCE.

The company employs a large number of men as sweepers and scavengers, to clean streets, public lavatories, collect refuse etc. Public lavatories and baths, clean piped drinking water, central refuse bins and efficient sewage system are provided, and all houses in the post-war housing estates are provided with water closets and baths. Much, therefore, is done to control and prevent disease, but little can be done to persuade the uneducated population of the town to use these facilities, or make them realise the value of a little simple hygiene. This task will take many more years.

On April 1st, 1947, a scheme was instituted whereby all artisan employees reporting sick and regarded as dysenteric cases, whether on clinical grounds, or from initial stool examination, were admitted to the Company's Isolation Hospital for treatment. Any employee found to be a carrier of any of the dysenteries was likewise admitted. The scheme was initiated in an effort to reduce the incidence of the dysenterics by preventing cases or carriers spreading infection. The company of course, cannot provide hospital accommodation for the large numbers of dependents and non-employees in Abadan, so that this group will continue to be a source of infection, and will continue to transmit that infection.

E.

## UNUSUAL FEATURES, AND MODE OF INFECTION.

Out of a large number of autopsies carried out over the previous five years in Azerbaijan, a northern province of Persia, Selimkhanov<sup>26</sup> in 1947 reported finding ulceration of the large intestine due to *Balantidium Coli*, in 3 cases. Stshensovitch<sup>27</sup> in 1927 in a survey of 2,000 persons in Azerbaijan reported finding *Balantidium Coli* in 5.1%. These are the only references in the literature to Balantidiasis in Persia.

As previously mentioned, all cases in this series were Mohammedans. In accordance with their religion, therefore, they had no contact with pigs, which are considered unclean, nor had they ever consumed pork.

Thus, in this series, the pig can be excluded as the source of infection. This is in accordance with the conclusion reached by Ostroumov<sup>8</sup> following examination of pigs and slaughter house workers in Soviet Central Asia.

In the whole series, the mortality was nil, and only in a few cases where the *Balantidium Coli* was the sole cause of the illness, could the patient be described as being really ill. The impression gained was that the disease was mild, and in many cases, chronic, but many fatal cases have been reported.

No cysts were discovered in the stools of any case.

No source of infection, apart from the human cases, was discovered in this outbreak.

Intestinal contents of sheep and cattle killed in the town slaughter-house were examined, and no *Balantidia* found.

The excreta of goats and samples of river water revealed no Balantidia.

Following the conclusion of this investigation on December 31st, 1948, cases occurred much less frequently, but all continued to be admitted to the Isolation Hospital for treatment.

I left Abadan in September 1949 but Dr. I.S. Stewart, Pathologist to the Anglo-Iranian Oil Co. Ltd., Abadan, recently informed me in a personal communication, that a case of Balantidiasis is now somewhat of a rarity.

A human to human transmission of the infection therefore seems to be established.

F.

## TREATMENT

Two cases were admitted to Hospital with positive stool reports, but subsequently, no Balantidia were found. No treatment was given in these two cases.

Sulphaguanidine.

Sulphaguanidine was given to seven cases of uncomplicated balantidiasis. 20 gm. was given daily. 3 cases received a total of 20 gm. each, one case 40 gm., one case 60 gm., one 80 gm. and one 100 gm.

Mepacrine.

As mepacrine had proved successful in the treatment of Giardiasis, it was given a trial. 5 cases each were given mepacrine .1 gm. thrice daily. One case in this group, had previously received sulphaguanidine, 80 gm.

Mercury Biniiodide.

In view of Shun-Shin's<sup>24</sup> success with mercury biniiodide, 5 cases were given two intramuscular injections of 1/2 gr. with an interval of two days between injections.

Stovarsol.

Eleven cases were given stovarsol gr. 4 thrice daily for 5 days, a total of 60 gr. Fifty cases were given stovarsol gr. 4 thrice daily, until the stools became negative, when treatment was stopped. Of these fifty, three cases had one day's treatment (12 gr. stovarsol), eleven had two day's (24 gr.), twenty-seven had three day's (36 gr.) and nine had four day's treatment (48 gr.).

Twenty cases which were positive at follow-up or relapsed within six months, were also treated with stovarsol until the stools

became negative. Six cases had 2 days treatment (24 gr.), eleven had 3 days (36 gr.) and three had 4 day's (48 gr.). (See Table II ).

Thirteen further cases were treated in similar manner, i.e. with stovarsol, but as these subsequently left the employ of the Company, or were non-employees and could not be traced for follow-up, they are excluded from further mention in this series.

The treatment is summarised in Table I.

Table I.

No. of cases treated	Drug used	Daily dose	No. of days treatment	Method of administration
x 7	Sulphaguanidine	20 gm.	1 to 5	Oral
x 5	Mepacrine	.3 gm.	5	Oral
x 5	Mercury biniodide	1/2 gr.	2	Intramuscular injection
11	Stovarsol	12 gr.	5	Oral
50 plus 20 follow-up	Stovarsol	12 gr.	1 to 4	Oral

No treatment - 2 cases.

x Some of these cases were treated with two different drugs.

Table II summarises the number of days treatment and quantity of stovarsol administered to the last fifty cases of the series and those cases positive at follow-up or with relapse, before the stools became negative.

Table II

No. of cases	Days of treatment	Quantity of stovarsol (grs.)
3	1	12
17	2	24
38	3	36
12	4	48

Average number of days treatment: 2.84

Average quantity of stovarsol given: 34.1 gr.

G.

## IMMEDIATE RESPONSE TO TREATMENT

Seven cases were treated with sulphaguanidine. In four the stools became negative, and in three, remained positive.

Five cases were treated with mepacrine. In no case did the stools become negative.

Five cases were treated with mercury biniodide by injection. In no case did the stools become negative.

One case who had concomitant amoebic dysentery received ten intramuscular injections of emetine hydrochloride gr. 1 but *Balantidium Coli* persisted in the stools.

Sixty-one original cases, two relapses within six months, and eighteen positive follow-ups, were treated with stovarsol. No case failed to respond to this treatment, the stools becoming negative in every case.

In two cases who had no treatment, the stools spontaneously became negative.

H.

## RESULT OF FOLLOW-UP.

Of the two cases which had no treatment, one had a negative, and one a positive stool, six months later.

The one positive was treated with stovarsol until the stools became negative, and six months later the stools were still negative.

Sulphaguanidine, mepacrine, or mercury biniodide, or a combination of these drugs, was used in the treatment of seventeen cases. All these cases had a positive stool at follow-up after six months. All were negative six months later, after treatment with stovarsol.

Of the sixty-one cases treated with stovarsol at the outset two relapsed, one in one month, the other in two months. Four had a positive stool on follow-up, and fifty-five a negative stool. The two relapses and four positive follow-ups were treated again with stovarsol, and all had a negative stool six months later.

All cases in the series, therefore, were permanently cured by stovarsol, although two treatments were required in six cases.

Table III summarises the immediate response to treatment and result of follow-up.

No. of cases	Treatment given	Imm. result of treatment		Relapses	Follow-up.	
		Stool pos.	Stool neg.		Stool pos.	Stool neg.
2	None	-	2	-	1	1
7	Sulphaguanidine	3	4	-	7	-
5	Mepacrine	5	-	-	5	-
5	Mercury biniodide	5	-	-	5	-
61	Stovarsol	-	61	2	4	55

I

## CASE REPORTS.

The social and economic conditions and environment of each case were approximately the same. The patients lived in mud or mud-brick houses in Abadan Town or nearby native villages. Unless otherwise stated in individual reports, there was no indoor water supply, nor sanitation. All cases were Persian artisans or labourers.

Case No. I.

Occupation: Lead Burner Age: 26 years.

Movements during last two years:

Not out of Abadan.

Contact with animals:

None, during past seven years.

Past History:

One attack of diarrhoea lasting 3 days, 1 year ago. He did not pass blood and was not off work.

Present Attack:

Patient was admitted to hospital complaining of diarrhoea, of two days duration, and central abdominal pain which was completely relieved by stool. The bowels were open about five times daily, but he had not seen any blood. He had vomited twice, the day before admission.

Examination:

Abdominal Tenderness: Localised midway between umbilicus and left anterior superior iliac spine.

Palpable Masses: Sigmoid colon palpable.

Case 1 continued.

Examination continued.

Proctoscopic Findings: Seven inches of bowel examined. No lesion seen. Soft faeces present.

Stool:

Macroscopic: Loose brown.

Microscopic: No cells. Vegetative Balantidium Coli present.

Culture: No pathogenic organisms.

Treatment:

Sulphaguanidine gm. 20 was given in divided doses over a period of 24 hours.

The following day, Balantidium Coli were scanty in the stool, and after two days, were no longer present. Pain disappeared on the second day, and the patient was discharged well.

Follow-up: (6 months)

The patient had remained well, apart from occasional abdominal pain, relieved by stool.

Stool: No cells. Vegetative Balantidium Coli present, and ascaris ova.

Patient was re-admitted to hospital and treated with stovarsol gr. IV thrice daily for three days, after which Balantidium Coli disappeared from the faeces.

Following santonin gr. III, one adult ascaris was passed.

On discharge, the patient stated his abdominal pain was completely gone.

A further six months later, the man had remained well, and there were no Balantidium Coli in his stool.

Case No. 2.

Occupation: Plant Attendant.

Age: 23 years.

Movements during last two years:

Not out of Abadan.

Contact with animals:

Sheep are kept at his home, but he has little contact with them.

Past History:

No previous attacks of diarrhoea.

Present Attack:

The patient first stated that he had had diarrhoea for five days, then complained of fever for eleven days, and abdominal discomfort due to constipation. The impression gained was that the man had reported sick for no very good reason at all.

Examination:

Abdominal Tenderness: Nil.

Palpable Masses: Nil.

Proctoscopic Findings: Seven inches of bowel inspected. Nil abnormal seen.

Stool:

Macroscopic: Loose brown.

Microscopic: No cells. Vegetative *Balantidium Coli* and *Trichostrongylus* ova present.

Culture: No pathogenic organisms.

Treatment:

Mepacrine .1 gm. thrice daily was given, for five days.

The stools remained positive for *Balantidium Coli*, and the patient was discharged.

Case No. 2 continued.Follow-up: (6 months)

The patient was well, but *Balantidium Coli* were still present in the stool.

He was re-admitted, and treated with stovarsol gr. IV thrice daily for three days. On the fourth day, the stools were negative.

On further follow-up six months later, the stools were still negative.

Case No. 3.Occupation:

Lead Blender.

Aged: 35 years.Movements during last two years:

15 months in Abadan. The previous 9 months, he worked on the land, some 300 miles North of Abadan.

Contact with animals:

Contact with sheep and cattle, previous to coming to Abadan.

Past History:

No previous history of diarrhoea.

Present Attack:

Duration of symptoms 4 days. The patient complained of fever, malaise, anorexia, diarrhoea and vomiting, with abdominal pain. The pain was relieved by stool, and he had noticed blood in his motions, on several occasions. For the last two days, there had been some tenesmus. The bowels moved 8 - 10 times daily.

Examination:

Abdominal Tenderness: Caecum and sigmoid colon tender.

Case No. 3 continued.Examination continued.

Palpable masses: Caecum and sigmoid colon thickened and palpable.

Proctoscopic Findings: Seven inches of bowel inspected. A few small hyperaemic areas seen in upper rectum. First degree haemorrhoids present.

Stool:

Macroscopic: Unformed brown with mucus.

Microscopic: Many pus cells and red blood corpuscles.  
Balantidium Coli present.

Culture: B. Dys. Flexner.

Treatment:

On receipt of the positive stool culture treatment with sulphaguanidine 20 gm. daily was commenced.

After one day's treatment, Balantidium Coli disappeared from the stool.

The patient's condition improved steadily, and after 5 days treatment (100 gm. sulphaguanidine) the stools were normal. Proctoscopy revealed no abnormality apart from the haemorrhoids.

Two negative stool cultures were obtained, and the patient discharged.

Follow-up: (6 months)

Patient was well, but the stools contained Balantidium Coli. He was re-admitted, and treated with stovarsol gr.IV thrice daily for two days. The stool then being negative, the man was discharged.

A further six months later, the stools remained negative.

Case No. 4.

Occupation: Pointsman

Age: 26 years.

Movements during last two years:

Not out of Abadan.

Contact with animals:

None.

Previous History:

Never had diarrhoea before.

Present Attack:

Diarrhoea of one day's duration. Circum-umbilical pain, not relieved by stool. No blood had been seen and patient felt quite well.

Examination:

Abdominal Tenderness:

Circum-umbilical only.

Palpable Masses:

Nil.

Proctoscopic Findings:

Seven inches of bowel inspected.

Nil abnormal seen.

Stool:

Macroscopic:

Unformed brown.

Microscopic:

Balantidium Coli and Ascaris ova present.

Culture:

No pathogenic organisms.

Treatment:

Since, for a week following admission to hospital, no Balantidium Coli were found in the stools, no treatment was given.

Following treatment for his Ascaris infection, the patient's abdominal pain disappeared, and he was discharged.

Follow-up: (6 months)

Patient had remained well, and no Balantidium Coli were found in the stools.

Case No. 5.

This patient was given sulphaguanidine 20 gm. in one day. The stools became negative for *Balantidium Coli* on the second day.

On follow-up, the stools were again positive. Stovarsol was given for three days, and the stools became negative.

Six months later, the stools were still negative.

Case No. 6.

Occupation:                      Ward boy                      Age: 40 years.

Movements during last 2 years:

Apart from 15 days leave in Bushire, a southern province of Persia, 9 months ago, he had not been off Abadan Island.

Contact with animals:

None, since 5 or 6 years ago.

Past History:

Two previous attacks of diarrhoea during the past year. He could not say how long each attack had lasted.

Present Attack:

The patient was admitted to hospital complaining of diarrhoea of 4 day's duration, with pain in the left lower abdomen and some tenesmus. The pain was relieved by stool. His bowels were open about six times daily, and some blood had been noticed on several occasions. There were no other symptoms.

Examination:

Abdominal Tenderness:                      Tender over ascending and descending colon.

Palpable Masses:                              Sigmoid colon thickened.

Case No. 6 continued.Examination continued.

Proctoscopic Findings: Seven inches of bowel inspected. Hyperaemia and small haemorrhages from upper rectum. A rectal swab showed many Balantidia on microscopic examination.

Stool:

Macroscopic: Loose brown, with blood and mucus.

Microscopic: Many red blood cells and pus cells. Vegetative Balantidium Coli, Ascaris ova, and Trichostrongylus ova present.

Culture: No pathogenic organisms.

Treatment:

Mepacrine .1 gm. thrice daily was given for five days.

Following this, the patient felt well and diarrhoea had ceased, but motile Balantidium Coli were still present in the stools.

Two intramuscular injections of mercury biniodide gr.  $\frac{1}{2}$  were given, with a two day interval between injections.

The stools remained positive.

Following santonin gr. III and a purge, seven round worms were passed. The patient was discharged.

Follow-up (6 months)

Patient had had two attacks of diarrhoea lasting two and five days. No blood had been seen, but there had been some abdominal pain. He had not reported sick.

The Stools contained Balantidium Coli.

The man was re-admitted to hospital, and treated with

Case No. 6 continued.Follow-up continued.

stovarsol gr.IV thrice daily for two days. The stools became negative, and he was discharged.

A further follow-up six months later revealed no recurrence of the diarrhoea and the stools negative for Balantidium Coli.

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Case No. 7.

This patient was treated with sulphaguanidine 20 gm. The stools became negative, but were positive on follow-up six months later.

Treatment with stovarsol was then carried out. The stools became negative for Balantidium Coli, and were still negative on a further follow-up.

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Case No. 8.

Occupation: Jetties Worker.

Age: 24 years.

Movements during past two years:

The last six months had been spent in Abadan. The previous eighteen months in the Army, in Sultanabad, a township in the heart of Persia.

Contact with animals:

None since arrival in Abadan. Previously, with sheep, goats, donkeys and cattle.

Past History:

One previous attack of diarrhoea a year ago, while in the

Case No. 8 continued.Past History continued.

Army. He was hospitalised for 15 days, but could give no account of findings or treatment given.

Present Attack:

The patient complained of diarrhoea of one day's duration, with left sided abdominal pain, relieved by stool. There was some tenesmus, but no blood had been seen. He felt fevered, and had lost his appetite.

Examination:

Abdominal Tenderness: Localised in left iliac fossa.  
Palpable Masses: Sigmoid colon palpable.  
Proctoscopic Findings: Seven inches of bowel inspected. Mild hyperaemia of rectal mucosa. Some mucus present. There were large numbers of *Balantidium Coli* in the mucus.

Stool:

Macroscopic: Fluid stool with mucus.  
Microscopic: Many pus cells, red blood cells and *Balantidium Coli*.  
Culture: No pathogenic organisms.

Treatment:

Sulphaguanidine gm.60 was given in divided doses over three days. At the end of this time, the diarrhoea had stopped and the patient felt well, but vegetative *Balantidium Coli* were still present in the stools. Treatment with sulphaguanidine was stopped.

A few days later, diarrhoea with mucus in the stools recurred.

Two intramuscular injections of mercury biniodide gr.  $\frac{1}{2}$  were

Case No. 8 continued.Treatment continued.

given with an interval of two days. The condition remained unchanged, the stools still positive.

The diarrhoea ceased on a Kaolin mixture, and the patient was discharged, though the stools remained positive.

Follow-up (6 months)

There had been intermittent short bouts of diarrhoea, and the stools contained *Balantidium Coli*. The man was re-admitted to hospital and given stovarsol gr. IV thrice daily for three days.

The stools became negative, and were still negative on further follow-up, six months later.

Case No. 9.

Occupation: Bitumen Filler Age: 34 years.

Movements during last two years:

In Abadan all the time.

Contact with animals:

None.

Past History:

No previous attacks of diarrhoea.

Present Attack:

The patient complained of diarrhoea of one day's duration. He had abdominal pain above the umbilicus relieved by stool. His bowels had moved five times the day before admission, but he had not seen any blood.

Case No. 9 continued.Examination:

Abdominal Tenderness: Slightly tender just above umbilicus.

Palpable Masses: Nil.

Proctoscopic Findings: Seven inches of bowel examined. Granular hyperaemia of upper rectal mucosa. In scrapings of this area, were many Balantidium Coli.

Stool:

Macroscopic: Loose with some mucus.

Microscopic: Some pus cells and Balantidium Coli present.

Culture: No pathogenic organisms.

Treatment:

Mepacrine .1 gm. thrice daily was given for five days.

Although the stools became macroscopically normal, Balantidium Coli were still present on the sixth day.

Two intramuscular injections of mercury biniodide gr.  $\frac{1}{2}$  were given at an interval of two days.

The stools remained positive, and the patient was discharged.

Follow-up (6 months)

Patient's stool still contained vegetative Balantidium Coli.

He was re-admitted and treated with stovarsol for three days.

The stools became negative on the fourth day.

Further follow-up six months later, revealed no Balantidium Coli in the stools.

Case No. 10.

Occupation: Bitumen Filler

Age: 30 years.

Movements during last two years:

Not out of Abadan.

Contact with animals:

None.

Past History:

No previous attacks of diarrhoea.

Present Attack:

On admission, the patient complained of mild diarrhoea only, of three days duration. He had no pain and had not seen blood. His only other complaint was of slight headaches during the previous month.

Examination:

Abdominal Tenderness: None.

Palpable Masses: None.

Proctoscopic Findings: Seven inches of bowel inspected. Nil abnormal seen.

Stool:

Macroscopic: Loose brown.

Microscopic: Vegetative Balantidium Coli and Trichostrongylus ova present.

Culture: No pathogenic organisms.

Treatment:

Two injections of mercury biniodide gr.  $\frac{1}{2}$  were given at two days interval. The stools remained positive, and the patient was discharged.

Case No. 10 continued.Follow-up: (6 months)

The patient had remained well, but the stools still contained *Balantidium Coli*.

He was re-admitted and given stevarsol for four days.

The stools became negative, and were negative on further follow-up six months later.

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Case No. 11.

This patient had a concomitant infection with *B. Dys. Boyd*. He received a total of 80 gm. sulphaguanidine over four days. At the end of this time, his stool still contained *Balantidium Coli*. Mepacrine was given for five days, but the stools remained positive.

At follow-up, his stool was still positive. Stevarsol was given for 2 days, when *Balantidium Coli* disappeared from the stool.

Six months later, the stool was still negative.

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Case No. 12.

This patient was treated with two injections of mercury biniodide gr.  $\frac{1}{2}$ . The stools remained positive, and were positive at follow-up.

Following stevarsol for three days, the stools were negative six months later.

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Case No. 13.

Mepacrine was given to this patient for five days, but the

Case No. 13 continued.

stools remained positive. They were still positive on follow-up.

Stovarsol was given for two days, when the stools became negative, and had remained negative six months later.

Case No. 14.

Occupation: Electrician. Aged: 39 years.

Movements during past two years:

In Abadan for the past eight months. Previously in Isfahan, a town in northern Persia.

Contact with animals:

None at all.

Past History:

No previous attacks of diarrhoea.

Present Attack:

Admitted to hospital complaining of diarrhoea for 4 days, with abdominal pain and tenesmus. The pain was not relieved by stool. He had up to seven bowel movements a day, and had seen blood on several occasions. He complained also of headache, malaise, fever, and loss of appetite.

Examination:

<u>Abdominal Tenderness:</u>	In left lower abdomen.
<u>Palpable Masses:</u>	None.
<u>Proctoscopic Findings:</u>	Seven inches of bowel inspected. A few hyperaemic areas seen upper rectum.

Case No. 14 continued.Stool:Macroscopic: Mucus and blood.Microscopic: Many pus cells, red blood cells and Balantidium Coli present.Culture: B. Dys. Flexner.Treatment:

On receipt of the positive stool culture, sulphaguanidine 20 gm. daily was commenced, in divided doses. On the second day, patient was much improved. On the fourth day, the bowels were normal, and the patient felt well, but the stools still contained Balantidium Coli. Sulphaguanidine was stopped, 60 gm. having been given.

Two negative stool cultures were obtained, and the patient discharged.

Follow-up (6 months)

The man was well, but the stools still contained Balantidium Coli. He was re-admitted and given stovarsol gr. IV thrice daily for 1 day. The stools became negative, and he was discharged.

After a further six months, the stools were still negative.

Case No. 15.Occupation: WatchmanAge: 42 years.Movements during past two years:

Not out of Abadan at all.

Contact with animals:

None.

Case No. 15 continued.Past History:

No previous attacks of diarrhoea admitted.

Present Attack:

Complains of diarrhoea for two days, with abdominal pain relieved by stool. No blood had been seen, and he was quite well otherwise.

Examination:

<u>Abdominal Tenderness:</u>	None present.
<u>Palpable Masses:</u>	Slight thickening of caecum and sigmoid colon.
<u>Proctoscopic Findings:</u>	Seven inches of bowel examined. Hyperaemia of upper rectum, with some mucus present. Several small ulcerated areas were present. Scrapings of the ulcers contained many Balantidium Coli.

Stool:

<u>Macroscopic:</u>	Fluid brown with mucus.
<u>Microscopic:</u>	Many pus cells, a few red blood cells and Balantidium Coli present.
<u>Culture:</u>	No pathogenic organisms.

Treatment:

Stovarsol gr.IV thrice daily was given for five days. On the third day, the bowels were normal, the patient felt well, and Balantidium Coli had disappeared from the stools. After five days treatment, the stools were still negative, and the patient was discharged.

Case No. 15 continued.Follow-up: (6 months)

Patient had had one mild attack of diarrhoea since discharge from hospital, lasting two days. He had not been off work.

On examination his stool was now found to contain motile Balantidium Coli. He was re-admitted to hospital and given 12 gr. stovarsol daily for three days. His stool then became negative again.

Further follow-up six months later showed no Balantidium Coli present.

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Case No. 16.

Balantidium Coli disappeared spontaneously from the stools after admission to hospital, so no treatment was given.

At follow-up 6 months later, the stools were again positive. Stovarsol was given for two days, when the stools became negative, and were still negative on follow-up a further six months later.

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Case No. 17.

Occupation: Road Sweeper Age: 20 years.

Movements during past two years:

Apart from 3 months in Ahwaz, a town some 80 miles north of Abadan, ten months ago, he had not been out of Abadan.

Contact with animals:

Keeps sheep, but has no contact with other animals.

Case No. 17 continued.Past History:

One attack of diarrhoea two years previously, while doing military service. Hospitalised for 6 days. Was given white tablets to take.

Present Attack:

Admitted to hospital complaining of three days diarrhoea, with pain in the left iliac fossa which was relieved by stool. Bowels were open 5 - 7 times daily, and blood had been present on two occasions. He had no other complaints, and felt quite well.

Examination:

Abdominal Tenderness: In left iliac fossa.  
Palpable Masses: None.  
Proctoscopic Findings: Seven inches of bowel examined. Mild hyperaemia of the upper rectal mucosa.  
 Loose faeces present.

Stool:

Macroscopic: Loose brown, with blood and mucus.  
Microscopic: Many pus cells and a few red blood cells, and Balantidium Coli present.  
Culture: No pathogenic organisms.

Treatment:

Stovarsol gr. IV thrice daily was given for five days.

After two days treatment, Balantidium Coli had disappeared from the stools, and diarrhoea had ceased. After four days, pain had gone, and the stools were normal.

The patient was discharged well on the seventh day.

Case No. 17 continued.Follow-up: (6 months)

The man was well and had had no recurrence of diarrhoea. The stools contained no Balantidium Coli.

Case No. 18.

Occupation: Painter Age: 30 years.

Movements during past two years:

Has not been out of Abadan.

Contact with animals:

None.

Past History:

Patient has never had diarrhoea before.

Present Attack:

Admitted to hospital complaining of diarrhoea of five days duration. He had abdominal pain which was relieved by stool. He had noticed blood in his motions on several occasions, and complained also of some giddiness and muscular pains.

Examination:

Abdominal Tenderness: In left and right hypochondrium.  
Palpable Masses: Upper ascending colon thickened.  
Proctoscopic Findings: Seven inches of bowel examined. Nil abnormal seen. Soft faeces present.

Stool:

Macroscopic: Loose brown.  
Microscopic: Balantidium Coli (motile) and Trichostrongylus ova present.

Case No. 18 continued.Treatment:

Stovarsol gr. IV thrice daily for five days were given.

After the first day's treatment, Balantidium Coli disappeared from the stools. By the fourth day, all pain had gone, and the patient felt well.

Follow-up: (6 months)

There had been no recurrence of diarrhoea, and the stools were negative for Balantidium Coli.

Case No. 19.

Occupation: Boiler Maker      Age: 18 years.

Movements in past two years:

Never been away from Abadan.

Contact with animals:

None.

Past History:

One attack of diarrhoea a year ago. Hospitalised for five days - records show he had Flexner Dysentery.

Present Attack:

Complaining now of diarrhoea for two days. He has no pain and has not seen blood, his only other complaint being of a feeling of pulsation in the epigastrium.

Examination:

<u>Abdominal Tenderness:</u>	None.
<u>Palpable Masses:</u>	None.
<u>Proctoscopic Findings:</u>	Seven inches of bowel examined. Nil abnormal seen.

Case No. 19 continued.Stool:

Macroscopic: Unformed brown, with Taenia segments.

Microscopic: A few red blood cells, vegetative Balantidium Coli, and Taenia ova present.

Culture: No pathogenic organisms.

Treatment:

Stevarsol gr. IV thrice daily was given for five days.

After three days, Balantidium Coli disappeared from the stools, but the patient complained of some central abdominal pain.

On the seventh day filix mas treatment was given. About nine feet of tapeworm was passed but no head.

The patient was discharged on the tenth day, feeling well.

Follow-up: (6 months)

The patient was well. There had been no recurrence of diarrhoea, and there were no Balantidium Coli in the stools. Taenia ova were present.

Case No. 22.Occupation:

Fitter.

Age: 35 years.

Movements during past two years:

Not out of Abadan.

Contact with animals:

Fairly close, with sheep, goats, and cattle.

Past History:

Not had diarrhoea before.

Case No. 22 continued.Present Attack:

Admitted to hospital complaining of diarrhoea of one day's duration, with abdominal pain relieved by stool. The day before admission his bowels had moved five times, and he had noticed blood in the stool. He felt sick and tired, but otherwise had no complaints.

Examination:

Abdominal Tenderness: Tender in left iliac fossa.

Palpable Masses: None.

Proctoscopic Findings: Seven inches of bowel inspected. Many haemorrhagic areas and a few ulcers seen lower pelvic colon, and upper rectum. Blood and mucus in lumen of bowel. Many *Balantidium Coli* were present in scrapings from floor of ulcers.

Stool:

Macroscopic: Blood and mucus.

Microscopic: Many pus cells and red blood cells present. *Trichocephalus dispar* ova and vegetative *Balantidium Coli* present.

Culture: No pathogenic organisms.

Treatment:

Stovarsol gr. IV thrice daily for five days was given.

After the first day, no *Balantidium Coli* were seen, and by the third day, the stools were normal and the patient had no pain.

Before discharge from hospital, the proctoscopic appearance was normal.

Case No. 22 continued.Follow-up: (6 months)

The man had remained well, and no *Balantidium Coli* were seen on stool examination.

Case No. 26.

Occupation: Bitumen Filler Age: 30 years.

Movements during past two years:

For the last 13 months, in Abadan. Previously in his village near Shivaz, a town in the mountain ranges of south-east Persia.

Contact with animals:

Cattle in his village. None, since coming to Abadan.

Past History:

States he has never had diarrhoea before.

Present Attack:

Diarrhoea for four days, accompanied by central abdominal pain, relieved by stool. He felt fevered, and had vomited a few times. He had noticed a little blood in his stool once. Bowels were moving 5 - 8 times daily.

Examination:

Abdominal Tenderness: Over hepatic and splenic flexures of colon.

Palpable Masses: Ascending colon slightly thickened.

Proctoscopic Findings: Seven inches of bowel examined. No abnormality seen. Soft faeces present.

Stool:

Macroscopic: Loose brown.

Microscopic: *Balantidium Coli* present.

Case No. 26 continued.Stool continued:

Culture: No pathogenic organisms.

Treatment:

Stovarsol gr. IV thrice daily was prescribed. On the third day, the abdominal pain had gone, and he felt well. The morning specimen of stool on the fourth day contained no Balantidium Coli, and stovarsol was stopped, 36 gr. having been given over three days.

The stools remained negative for a subsequent two days, and the patient was discharged.

Follow-up: (6 months)

There had been no recurrence of diarrhoea, and no Balantidium Coli were present in the stools.

Case No. 27.

Occupation: Labourer. Age: 45 years.

Movements during last two years:

Not away from Abadan.

Contact with animals:

None.

Past History:

One previous attack of diarrhoea about a year ago, which lasted three days. He was not in hospital, and no further details were forthcoming.

Present Attack:

Patient complained of diarrhoea for one day only, but with the presence of blood in the stools. He had pain in the left iliac fossa,

Case No. 27 continued.

Present Attack continued.

relieved by stool, and tenesmus. The bowels had moved six times, the day before admission.

Examination:

Abdominal Tenderness: In left iliac fossa only.

Palpable Masses: None.

Proctoscopic Findings: Seven inches of bowel examined. Three small ulcerated areas, one haemorrhagic, seen, in lower pelvic colon. Scrapings contained many *Balantidium Coli*.

Stool:

Macroscopic: Blood and mucus only.

Microscopic: Many pus cells, red blood cells and vegetative *Balantidium Coli* present.

Culture: No pathogenic organisms.

Treatment:

Stovarsol gr. IV thrice daily was commenced. By the third day, the stools were microscopically normal apart from the presence of *Balantidium Coli*, and on the following day, these had disappeared from the stool.

Two days later, the patient was discharged, having had 36 gr. of stovarsol over a period of three days.

Follow-up: (6 months)

There had been no recurrence of diarrhoea, and *Balantidium Coli* were not present in the stools.

Case No. 28.

Occupation: Wireman

Age: 25 years.

Movements during last two years:

The previous one year had been spent in Abadan. Before that he was in Masjid-i-Sulaiwan, an oil-field in the hills, 150 miles from Abadan.

Contact with animals:

Sheep and cows in Masjid-i-Sulaiwan. None since coming to Abadan.

Past History:

Several mild attacks of diarrhoea over the last year. None lasted more than four days, and he had no medical treatment or investigation. No blood had been seen.

Present Attack:

Complaint was made only of diarrhoea, of two day's duration. No blood had been seen, he had no pain, and felt quite well. He reported sick because he had had similar attacks before.

Examination:

Abdominal Tenderness: None.

Palpable Masses: Liver one finger-breadth enlarged below costal margin.

Proctoscopic Findings: Seven inches of bowel inspected. No abnormality noted.

Stool:

Macroscopic: Loose brown.

Microscopic: Vegetative Balantidium Coli, Ankylostoma ova, and Trichostrongylus ova present.

Culture: No pathogenic organisms.

Case No. 28 continued.Treatment:

Stovarsol gr. IV thrice daily was given. Treatment was stopped on the fourth day, when the stools became negative. A vermifuge was given a few days later and the patient discharged.

Follow-up: (6 months)

The man had remained well. There had been no recurrence of diarrhoea. Ankylostoma ova were present in the stool, but no Balantidium Coli.

Case No. 29.Occupation:

Garage Worker

Age: 21 years.Movements during last two years:

Not out of Abadan.

Contact with animals:

None.

Past History:

No previous attacks of diarrhoea.

Present Attack:

Patient complained of diarrhoea for two days, with central abdominal pain, relieved by stool. The bowels had been open four times daily, loose, but no blood had been seen. He complained also of backache.

Examination:Abdominal Tenderness:

Circum-umbilical.

Palpable Masses:

Ascending colon thickened, and liver just felt.

Proctoscopic Findings:

Seven inches of bowel examined. No abnormality seen.

Case No. 29 continued.Stool:

Macroscopic: Loose brown.

Microscopic: Balantidium Coli present.

Culture: No pathogenic organisms.

Treatment:

Stovarsol gr. IV thrice daily was given.

On the second day, pain had gone, the stool contained no Balantidium Coli, and treatment was stopped.

Follow-up: (6 months)

The patient was well, and no Balantidium Coli were found in the stools.

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Case No. 30.

Occupation: Labourer Age: 45 years.

Movements during past two years:

Not out of Abadan.

Contact with animals:

None.

Past History:

No previous attacks of diarrhoea.

Present Attack:

Diarrhoea for three days, with sometimes slight tenesmus.

There was no abdominal pain and no blood had been seen.

Examination:

Abdominal Tenderness: None.

Palpable Masses: None.

Case No. 30 continued.Examination continued:

Proctoscopic Findings: Seven inches of bowel inspected. A few small greyish ulcers seen in lower pelvic colon. Scrapings contained many *Balantidium Coli*.

Stool:

Macroscopic: Loose brown.  
Microscopic: *Balantidium Coli* present.  
Culture: No pathogenic organisms.

Treatment:

Stovarsol gr. IV thrice daily was commenced. On the third day, *Balantidium Coli* had disappeared from the stools and treatment was stopped.

Proctoscopy, before discharge two days later, showed normal appearances.

Follow-up: (6 months)

No recurrence of diarrhoea had occurred, and the stools were negative for *Balantidium Coli*.

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The last five case histories are typical of those of the remainder of the series, except for cases 33, 38, 47, 56, 60 and 68 which are described below. Cases 32, 51 and 53 were positive on follow-up. They were again treated with stovarsol, and at subsequent follow-up no *Balantidium Coli* were found.

Case No. 33.

Occupation: Sweeper Age: 34 years.

Movements during past two years:

The past year has been spent in Abadan. Previously, he lived in his village near Shiraz.

Contact with animals:

Sheep in his village. None since coming to Abadan.

Past History:

He has had bouts of diarrhoea, usually with some abdominal pain, off and on, for some years. He has never had medical treatment for these.

Present Attack:

The present bout had lasted one day before admission. He complained of tenesmus and pain in the right hypochondrium. He also had backache and complained of loss of weight, and appetite, and general malaise.

Examination:

Abdominal Tenderness: Ascending colon tender.

Palpable Masses: Ascending colon thickened, and liver felt.

Proctoscopic Findings: Seven inches of bowel examined. No abnormality seen.

Stool:

Macroscopic: Semi-fluid, yellowish faecal matter streaked with mucus.

Microscopic: Scanty red blood cells, Charcot-Leyden crystals, vegetative Entamoeba Histolytica and Balantidium Coli present.

Culture: No pathogenic organisms.

Case No. 33 continued.Treatment:

Emetine hydrochloride gr.1 was given by intramuscular injection daily for 10 days.

By the eleventh day, Entamoeba Histolytica had disappeared from the stools, but Balantidium Coli were still present. The patient felt well.

Stovarsol gr.IV was given thrice daily for five days.

Balantidium Coli disappeared from the stools on the third day.

Retention enemata of Yatren were given for five days.

Follow-up: (6 months)

The patient was well. He had had no recurrence of diarrhoea. No Balantidium Coli were found in the stools. Entamoebae were also absent.

Case No. 38.

Occupation: Labourer

Age: 48 years.

Movements during last two years:

Has not been out of Abadan.

Contact with animals:

None.

Past History:

Intermittent attacks of diarrhoea for the past six years. He was never in hospital, but on several occasions received medicine at the out-patient's department. No record of the treatment he had was available. The attacks had sometimes been accompanied by pain, and he had sometimes seen blood. He had not lost weight, and on the whole felt quite well.

Case No. 38 continued.Present Attack:

On admission, diarrhoea had been present for three days. The bowels were moving three to eight times daily. He had no pain, but blood had been seen on several occasions. There was some tenesmus.

Examination:

Abdominal Tenderness: Located in left iliac fossa.  
Palpable Masses: Sigmoid colon thickened.  
Proctoscopic Findings: Seven inches of bowel examined. Many small ulcers seen in lower pelvic and upper rectal mucosa. Little surrounding inflammatory reaction. Scrapings showed many *Balantidium Coli* present.

Stool:

Macroscopic: Blood and mucus.  
Microscopic: Many pus cells, red blood corpuscles and *Balantidium Coli* present.  
Culture: No pathogenic organisms.

Treatment:

Stovarsol gr. IV thrice daily was commenced.

On the second day, the stools were macroscopically normal, but cells were still present microscopically and *Ankylostoma ova* were present.

On the third day *Balantidium Coli* were absent and also the inflammatory cells.

Treatment for the ankylostomiasis was given, and the patient discharged well.

Three weeks later, the patient was re-admitted to hospital with

Case No. 38 continued.Treatment continued.

a recurrence of diarrhoea. Balantidium Coli were again present in the stools, but no blood.

Proctoscopy showed essentially the same picture as before.

Stovarsol medication was again commenced, as before.

Balantidium Coli persisted in the stools until the fifth day.

Treatment was then stopped, 48 gr. of stovarsol having been given.

Proctoscopy on discharge, showed normal appearances.

Follow-up: (6 months)

There had been no recurrence of diarrhoea, and there were no Balantidium Coli in the stools.

Case No. 47.

Occupation:                      Labourer                      Age: 34 years.

Movements during last two years:

Nine months ago he went to Teheran for five months. The rest of the two years was spent in Abadan.

Contact with animals:

Only with hens.

Past History:

No previous attacks of diarrhoea admitted.

Present Attack:

Complained, on admission, of diarrhoea for eight days, with frequent vomiting. The bowels were open 4 - 7 times daily, and blood had been noticed. He had some pain across the upper abdomen, which was relieved by stool. There was loss of appetite, aches and pains, and he felt fevered.

Case No. 47 continued.Examination:

Abdominal Tenderness: Present across the upper abdomen and on the left side.

Palpable Masses: The caecum was thickened.

Proctoscopic Findings: Seven inches of bowel inspected. Many areas of hyperaemic and several ulcers present in the lower pelvic colon. Scrapings from these showed many *Balantidium Coli*.

Stool:

Macroscopic: Loose brown with a little blood.

Microscopic: A few red blood cells, many pus cells, vegetative *Balantidium Coli* and *Trichostrongylus ova* present.

Culture: No pathogenic organisms.

Treatment:

Stovarsol gr. IV thrice daily was given.

On the third day, the stools were normal apart from the presence of *Balantidium Coli* and *Trichostrongylus ova*, and the patient felt well. The following day *Balantidium Coli* had disappeared, and treatment was stopped, 36 gr. of stovarsol having been given.

Proctoscopy done before discharge two days later, showed normal appearances.

Two months later, this patient was re-admitted with a recurrence of abdominal pain, and diarrhoea. *Balantidium Coli* were present in the stools. Proctoscopy showed normal appearances.

Stovarsol was administered for two days, after which *Balantidium*

Case No. 47 continued.Treatment continued.

Coli were no longer found in the stools.

Follow-up: (6 months)

There had been no recurrence of diarrhoea, and the patient was well. No *Balantidium Coli* were present in the stools.

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Cases Nos. 56, 60 and 68.

These patients had concomitant Balantidiasis and Bacillary Dysentery. On admission to hospital, stovarsol was given immediately, and sulphaguanidine therapy instituted on receipt of the positive stool culture report.

All these cases were negative on follow-up.

J.

## DISCUSSION

The pathology of Balantidiasis has been thoroughly investigated by several workers (Strong<sup>14</sup>, Walker<sup>6</sup> and more recently Koppisch and Wilking<sup>16</sup>). There is no divergence of opinion as to the type of lesion produced or the degree of severity these lesions may attain.

Two main problems of Balantidiasis remain to be solved, firstly, the mode of spread, and second, its treatment.

Opinion is divided, as to whether or not the pig plays any part in human Balantidiasis. Walker<sup>6</sup> is of the opinion that pigs serve as a reservoir for human infection, and Craig and Faust<sup>5</sup> state that 25% of cases give a history of contact with pigs. Neither, however, produces undisputable evidence of the transfer of the infection from a pig to man. The evidence to support the theory of infection being contracted from pigs is therefore only presumptive.

Ostroumov<sup>8</sup>, after studies of abattoir workers, states he is convinced that the pig plays no part in the epidemiology of human balantidiasis. Ferri<sup>28</sup>, from observations on a group of children in a mental hospital in Tonsk, concluded the infection was passed from child to child.

In the series just described, it is certain that pigs played no part in transmission of the disease.

It may be concluded therefore, that Balantidiasis may be contracted from pigs, but it is certain that the disease can be transmitted without the pig acting as an intermediate host.

In the group of children studied by Ferri<sup>28</sup>, no cysts were seen. Neither in my series, were any cysts seen in numerous stool examinations in each of seventy-four cases. It, therefore, seems a logical conclusion, that transmission can occur in the active ciliate state, although the generally accepted theory is that infection occurs by the swallowing of cysts.

A few experiments have been carried out on human volunteers in an endeavour to produce human Balantidiasis.

The first experiment of this nature was carried out in 1896. Andrews<sup>29</sup>, cites Cassagrandi and Barnagallo as having in that year, fed balantidium from man and pigs, to humans, but failed to infect the volunteers. Ziemann, in 1925, again cited by Andrews<sup>29</sup>, fed balantidium from chimpanzees to humans, but also failed to infect them. In view of the number of different species of balantidium described since those early experiments, however, we cannot be sure it was Balantidium Coli which was actually used.

Knowles and Das Gupta<sup>30</sup>, in 1934 fed trophozoites and cysts of balantidium from the monkey Macacus Rhesus, to two men. Neither developed balantidiasis. However, it is now known that the rhesus monkey is infected by a species Balantidium simile, which is not pathogenic to man, and balantidiasis would not, therefore develop.

Recently, Young<sup>31</sup>, has published data on his experiments. He fed cysts and vegetative Balantidium Coli in gelatin capsules to two volunteers. Over a period of 10 years, neither developed diarrhoea, or ever passed cysts or trophozoites in the stools. The ciliates given,

were obtained from a human case, and it is stated that both the cystic and vegetative forms were alive when put in the capsules. It cannot be proved however, that these were still alive when they were shed from the capsules into the gastro-intestinal tract. The result of this experiment would unfortunately therefore still seem to be open to doubt.

The mode of transmission of Balantidiasis remains open to debate.

As long ago as 1929, Sweeney<sup>32</sup>, carried out experiments on guinea pigs with balantidiasis in an endeavour to find a suitable drug in treatment. Of many substances tried, she found the arsenicals gave best results, and more particularly stovarsol, tryparsamide and parason. In view of this work, it is perhaps surprising that these drugs have not been given a more extensive trial in the treatment of human balantidiasis. The only reference I have found in the literature to stovarsol being used is that of Atilas<sup>20</sup>. My own results in this series, would indicate stovarsol to be of definite value. I was unable to confirm the success of mercury biniiodide, as used by Shun-Shin<sup>24</sup>, and Pramanik<sup>25</sup>.

## SUMMARY AND CONCLUSIONS.

*Balantidium Coli*, a ciliate first described by Malmsten in 1857, is an infrequent cause of dysentery in man. It is a common inhabitant of the intestine of pigs.

It produces lesions in man, mainly in the large intestine, these lesions being indistinguishable from amoebic ulceration. Perforation of the ileum is recorded, but is very rare. The parasite invades blood vessels and lymphatics of the gut, but has never been known to cause liver abscess.

Balantidiasis is usually a mild or chronic disease. It is diagnosed by finding the ciliate or cysts in the stools. A mortality rate of 7% - 29% has been quoted.

Treatment has so far been varied. Few workers have had success using the same drugs.

The outbreak described occurred among the native artisans and labourers employed by the Anglo-Iranian Oil Co. Ltd., on Abadan, an arid island at the head of the Persian gulf.

The average native in this class lives under primitive conditions, has no idea of simple hygiene, and is little interested in such. Conditions are therefore suited to the spread of disease.

By employing large numbers of street cleaners and sanitary workers, and providing the usual social amenities of a modern town, the Oil Co. does much to control and prevent disease.

Balantidiasis has been reported in 3 autopsies carried out in Azerbaijan, and in 5.1% of 2,000 persons examined there. These are the only reports of the disease in Persia, and no study of the disease

in that country has been published. All cases in the series were Mohammedans, and did not have any contact with pigs. The mortality in the series was nil, and the disease was on the whole mild. No animal source of the ciliate was discovered. Following hospitalisation and treatment of all cases found in Abadan over a period of eighteen months, the disease has become a rarity in that town.

Sulphaguanidine, mepacrine, mercury biniodide, and stovarsol were used in treatment of cases in the series. Of these, only stovarsol effected a permanent cure.

A number of typical case histories are given in detail.

It is concluded that:-

1. Balantidiasis is generally a mild or chronic disease.
2. In this series, pigs played no part in transmission of the disease.
3. A human to human transmission is established.
4. Stovarsol is an effective drug in the treatment of Balantidiasis.

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