The following cases are illustrative of this form of treatment:

CASE I.

C. H., aged 8 months, was admitted with a history of convulsions. The facial phenomenon was markedly positive and there was severe laryngismus, with increased electrical excitability. On February 15th, 1922, administration of calcium chloride, 30 grains every four hours, was commenced. No more convulsions occurred and on February 18th all signs of tetany had disappeared and the electrical reactions were normal. Calcium chloride was accordingly discontinued; cod-liver oil was given, and fifteen days later the patient was dismissed from hospital perfectly well, all signs of tetany being absent.

CASE II.

A girl, aged 11 years, was admitted with late rickets and pyuria. On March 27th, 1924, the patient suddenly developed severe carpopedal spasm, the pain of which caused her to cry out. There was a very marked facial phenomenon and greatly increased electrical excitability, a cathodal opening contraction being elicited with 0.8 milliamperé. At 4 p.m. 30 grains of calcium chloride were given by mouth. At 5.10 p.m. carpopedal spasm had entirely disappeared and the child was absolutely free from pain. The facial phenomenon was still very marked, and Trousseau's sign was readily elicited. Calcium chloride was therefore continued, and, on March 19th, there had been no return of the spasm, the facial phenomenon was negative, and the cathodal opening contraction was elicited with 4.5 milliamperés. Calcium chloride was discontinued and cod-liver oil commenced. On April 2nd the facial phenomenon had reappeared, but there has since been no other sign of tetany.

CASE III.

M. F., aged 9 months, was admitted with marked laryngismus and positive Trousseau's sign, and gave a history of frequent convulsions. The facial phenomenon was markedly positive. On February 5th, 1924, calcium chloride, 30 grains every four hours, was prescribed, with cod-liver oil in 30-minim doses three times a day. There were no more convulsions. After three doses of the calcium chloride Trousseau's sign was negative, there was no facial phenomenon, and the presence of laryngismus was doubtful. The calcium chloride was stopped, but two days later signs of tetany returned. After three doses of calcium chloride they again disappeared, and six days after the beginning of treatment the patient was discharged from hospital, no sign of tetany being then present.

The following two abstracts illustrate the similarity in the action of ammonium chloride:

CASE IV.

J. M., aged 12 months, was admitted with a history of convulsions. Trousseau's sign and the facial phenomenon were positive, and there was increased electrical excitability. Ammonium chloride 30 grains were given every four hours, and after six doses all signs of tetany had disappeared.

CASE V.

A. Q., aged 11 months. On admission the facial phenomenon was positive and laryngismus and carpopedal spasm were present. The administration of ammonium chloride, 30 grains every four hours, was followed in two days by the disappearance of all signs of tetany.

The following case is of special interest in view of the age of the child, the absence of rachitic changes, and the fact that none of the classical signs of tetany were present on admission, though the subsequent course of events justified a diagnosis of tetany:

CASE VI.

W. B., aged 15 days, was admitted on account of generalized convulsions which were occurring so frequently that they could not be counted. Facial phenomenon and Trousseau's sign were negative; there was no marked increase in electrical excitability, and no history of laryngismus was elicited. The calcium content of the serum on this date was 5.6 mg. per 100 c.cm. Treatment by 10 grams of calcium chloride every four hours was begun. Four mild convulsions occurred after the commencement of the administration of the drug, but within two days they had ceased and have not since recurred. The calcium was discontinued after three days, when the child developed mild laryngismus and a positive Trousseau's sign, thus justifying the diagnosis of tetany.

It is generally recognized that active tetany in the infant is a disease requiring urgent treatment. Deaths from convulsions figure largely in the infant mortality statistics, and it seems probable that many of these convulsions are due to tetany. Treatment of such cases by calcium chloride has been attended with such invariable success in our hands, as well as in the hands of some others, that we feel justified in making a plea for the wider use of a treatment which is simple to use and unattended by any risk to the patient.

REMARKS ON THE DIAGNOSIS AND TREATMENT OF CHRONIC INTUSSUSCEPTION.*

BY

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CHRONIC intussusception in children is a somewhat rare complaint. According to Morison "the chronic variety may be called a disease of adults, and the acute one of children, but there are exceptions to both these statements."¹ Still recently reported four cases of the condition seen in eight years. He draws attention to it on account of its rarity and the fact that the diagnosis is often missed, as the usual idea of intussusception is a case of acute obstruction with bloody stools. He uses the word "chronic" "to mean cases in which the intussusception is present for many days or even weeks without producing any acute obstruction." I quote his excellent description of a typical case in full:

"On a particular day the child seemed to have pain in the abdomen and vomited once or twice. During the next few days he occasionally vomited, generally in association with a colicky pain. The vomiting has become less frequent, only once in two or three days, and the pain is only occasional. The bowels, which before were open daily, have since the onset been less regular; aperients have been necessary, but when given have worked well and the stools have been normal; there has been no blood in the stool, or at most there has been only a streak once or twice, such as might be seen on the stool of any constipated child. The symptom which has troubled the parents most is the wasting; the child after three or four weeks of these vague troubles is obviously getting thin. The temperature throughout has been normal."²

The diagnosis is made by feeling the sausage-shaped tumour, which varies in consistence under the fingers at different times, and by the sense of unnatural emptiness in the right iliac fossa—a negative sign which, personally, I always find difficult to elicit. Dr. Still recommends examination of the child when asleep as of great help in feeling the tumour, but states that the association of the transverse tumour with wasting led to a diagnosis of tuberculous peritonitis being made by one or other who saw the child, in all four of his cases. X rays were used in only one case and did not help in diagnosis. All his cases were operated on and did well; the ages of his patients were respectively 13 months, 14 months, 23 months, and 3½ years, and the corresponding duration of symptoms up to the time of operation respectively 32, 42, 32, and 21 days.

Morison mentions a case in a boy of 3½ years of ten days' duration. The medical attendant made a diagnosis of intussusception, but "this was rejected by an eminent physician who was called in consultation." Blood appeared in the stools on the ninth day. Mr. Morison confirmed the diagnosis and operated; reduction was easy and the patient did well.¹

Schlink reported a case of two months' duration in a girl of 7 years. There was a well marked tumour in the lower abdomen and a mass by the rectum, and emaciation was marked. X rays, after a bismuth meal, showed the case to be an intussusception. No blood had been passed, and the many diagnoses made by the many doctors who saw the girl included malignant disease of sigmoid, sarcoma of kidney, hydronephrosis, enlarged retroperitoneal glands, and malignant cyst of the ovary! Complete recovery followed operation.³

The following is the history of a case I treated recently.

I first saw the child, a girl of 6 years, on February 4th, 1923, on account of epigastric pain and vomiting, present since the previous day. A careful examination of the abdomen revealed nothing abnormal, and the symptoms were attributed to fish taken on February 3rd. On February 5th I saw her again and, as she appeared better, removed her name from my visiting list. On February 27th (I had been away a few days) my locum saw the child and promised I would call the following day. The mother then told me that "the child had not been really well since my visit on February 5th, as, though she was all right some days, on others she had had 'awful agony'; there had been no vomiting, and the bowels had been open daily without aperients; the child, however, had lost her appetite and was wasting to a shadow, and," the mother continued, "she was sure there was something radically wrong as the child had always been so bright before."

I now found that there was marked tenderness in the right iliac

* A paper read before the North Glamorgan and Brecknock Division of the British Medical Association, December 13th, 1923.

fossa, assured the mother she was quite right, that the child had chronic appendicitis, and advised operation. On March 1st I could feel a tumour in the region of the transverse colon and altered my diagnosis to *intussusception*. The child was admitted to hospital the same evening. On March 2nd—on the operating table—I did not feel nearly so certain of the tumour, nor would my colleague who assisted (a very skilled diagnostician) commit himself to a diagnosis. I made an incision as for appendicectomy and found an ileo-caecal intussusception. The apex of the intussusceptum had reached as far as the splenic region, but the intussusceptum was unravelled very easily. The intussusceptum was thickened, oedematous, anaemic, and greyish in colour—very different from the engorged and purple intussusceptum of an acute case. The appendix, which had accompanied the intussusceptum and partook of its characters, was removed and the stump buried with a purse-string suture; this was difficult on account of the thickening. No raw areas were seen, and no attempt at pleating the mesentery or at fixation of the caecum was made.

The symptoms had lasted twenty-eight days before operation was performed. There was never any rise of temperature or quickening of pulse whilst I had her under observation, nor was blood passed at any time. Rectal examination was always negative. The general condition, except for the wasting, had been excellent. I saw the child on May 8th and was astounded at the increase in weight.

It will be seen that the case closely resembled the clinical picture given by Dr. Still. I was impressed by its rarity at the time, but had not then seen Dr. Still's paper. The diagnosis of chronic appendicitis first made seems to be a variation from the usual. I did not even consider the possibility of tuberculous peritonitis; the sudden onset—a point on which Dr. Still lays stress—ruled it out. Not being well acquainted with the child, I must confess I did not realize the extent of the wasting; this I can better imagine now I have seen the increase in weight since operation, and the mother assures me that the child is just her normal weight. It was difficult to feel the tumour, as often happens in the acute cases. No vomiting took place after the first two days, and, extraordinary as it may seem—but I have closely questioned the mother on this point, and she is an intelligent woman—the bowels were open daily without purgatives; the child had not, however, eaten normally.

It will be noticed that, in spite of the difficulties in diagnosis, all the cases I have referred to recovered after operation. That this happy event is not invariable is exemplified by a very interesting case of chronic intussusception, of at least five months' duration, recorded by Spencer.⁴ In this case there was present an additional physical sign—namely, ascites.

This patient, a boy of 7½ years, presented the following features:

1. The first symptoms occurred "four months before his parents sought medical advice."

2. There was present "a tumour . . . in the epigastrium, associated with ascites of an extreme degree."

3. There was "marked wasting present, with intermittent abdominal pains and occasional vomiting, associated with regularity and even frequency of the bowels." The latter were, however, "constipated at first, but were kept open by purgatives."

4. At the beginning of the illness blood was present in the stools, "once bright red, and twice just sufficient to streak the stools." This child attended the out-patient department of the Great Ormond Street Hospital as a case of "abdominal tuberculosis" for several weeks, and on admission "a provisional diagnosis was made of tuberculous peritonitis with ascites and obstructive symptoms." Mr. George Waugh operated, and "in the upper abdomen a large, firm, and rigidly fixed tumour was found . . . apparently retroperitoneal." Death took place thirty-six hours later from general peritonitis, and *post mortem* "the tumour was found to be an intussusception."

This instructive case we may look upon as an instance of the terminal effects of a chronic intussusception. No doubt there was a stage in this case when no ascites was present—it is difficult to imagine parents so lax in seeking medical attention. Probably the other cases would in time have ended similarly if unrelieved by operation.

Are these cases commoner than we think, and do some of them, after causing a few symptoms which are labelled "bilious attacks," reduce themselves? That such is the case seems to be supported by Mr. Morison's account of a girl of 6 years, who was suffering from intussusception, but whose symptoms and tumour vanished on her removal to the infirmary; she had several attacks, followed each time by spontaneous reduction, and subsequently operation was performed—shortly after spontaneous reduction; evidence of the condition having existed was found, and the mesentery was pleated to prevent recurrence.¹ I saw a similar case a month or so ago—a very thin boy of 10. I have never seen a more typical case of tumour with visible peristalsis than was felt through his thin abdominal wall.

I advised the parents that I feared an operation would be necessary, but in a few hours the abdomen appeared normal and the symptoms—acute pain and bilious vomiting of two days' duration—had abated. Recently I was asked to operate on a young woman of 22, with the history that she had had three attacks of appendicitis. At operation I found a very similar condition of appendix and intestine, only to a lesser degree, as I found in the case detailed above. I do not remember having seen anything like it except on these two occasions, and I have no doubt that the case was one of chronic intussusception which had reduced itself, the attacks of "appendicitis" corresponding to the attacks of pain and vomiting observed in the other cases; the only difference was the age of the patient. I could get no history of a tumour from the medical attendant in this case, but in view of the difficulty of feeling "the tumour" one cannot attach much importance to this. As the mesentery was not pleated in this case nor the caecum fixed—and it was certainly very mobile—it will be interesting to see if removal of the appendix will be followed by freedom from further symptoms.

In the light of the case recorded by Mr. Spencer we can at least assume that a good many of these cases have been, and will continue to be, treated in sanatoriums, and who is to say the number that are counted yearly by the Registrar-General as cases of tuberculous peritonitis?

All the cases mentioned above were ileo-caecal, with the exception of one of Dr. Still's cases which was ileo-colic.

TREATMENT.

As in all other abdominal conditions, the earlier the diagnosis the easier the treatment. Fortunately the condition is very tolerant of the diagnostician, and even when it has lasted two months, as it did in Schlink's case, reduction may not be very difficult; but in a case of many months' duration such as Waugh's—where the parents were to blame—not only reduction but even diagnosis at operation may be impossible. With the exception of the last named case, reduction was fairly easy in all the cases reviewed above. After reduction some peritoneal tears on the wall of the intestine, from the separation of adhesions, may require a few Lembert's sutures.

In the event of the intussusception being irreducible or gangrenous, or both, the various operations for these conditions—namely, short-circuiting, removal of intussusceptum through the ensheathing layer, or resection with end-to-end union, will have to be considered, always on the assumption, of course, that the patient's condition is good and that the relations inside the abdomen can be made out. I should think that successful resection for a chronic intussusception in a child must be very rare; a case of Dowd's "of recovery after resection of a gangrenous subacute invagination in a boy of 4½ years" is mentioned in Jacobson.⁵ I have not seen the account of the case so do not know the duration of the disease. The mortality of resection must be very high; one cannot imagine the patient's condition to be very favourable for a severe operation. More often, I imagine, in a case of long standing, one would be confronted with the state of affairs that existed in Mr. Waugh's case, where everything was bound down by adhesions and it was impossible to do anything.

It is usually stated that the mesentery is unduly long, and the caecum and ascending colon unduly mobile in these cases; hence the question arises (in non-urgent cases): Is it advisable to shorten the mesentery by pleating, or to fix the caecum by suture⁶ or otherwise? It might be thought that once the intestine has formed a bad habit it is liable to continue with it. Certainly in Mr. Morison's case of recurrent intussusception it did so, and pleating cured the habit. If, therefore, one is satisfied that the habit exists in a particular case—and such cases are very rare—then one has an indication for one or other of these operations. Alexander reported a case of chronic intussusception in a boy of 4 years, which became acute after sixteen days' duration; he employed the appendix to tether a mobile caecum to the parietes, though he mentions as an additional reason for this procedure his desire to keep the caecum near the surface, as its viability was in doubt.⁷ Are any of these operations, with the reservation above (the recurrent case),

really necessary? With the exception of Morison's recurrent case and Waugh's case, they were performed in only one of the other eight cases mentioned—another reason for the performance being given. They were not performed in any of Dr. Still's cases, and though "the earliest was nearly eight years ago and the latest a year ago"² none had recurred.

My best thanks are due to Dr. G. F. Still for kindly supplying me with one of the references.

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TREATMENT OF TUBERCULOUS AFFECTIONS BY INFLATION WITH OXYGEN.*

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THE subject of this communication was first brought to our notice in a paper published by Lieut.-Colonel Rost, I.M.S., in the *BRITISH MEDICAL JOURNAL* of December 10th, 1921.¹ He stated that he was led to try oxygen gas in the treatment of various affections by the desire to reach the inaccessible parts of a psoas abscess. He reports altogether 32 cases, including psoas abscess, tuberculous peritonitis, tuberculous joints (with effusion), chronic synovitis, pyaemic abscess, and fibrous ankylosis of the knee-joint. The results he obtained were extremely good, improvement or cure having been obtained in almost every case.

During the past two years we have employed this method in a number of tuberculous cases and epitomize here notes of 21 of these which we have been able to trace and recently verify.

The method consists in evacuation of the abscess (by aspiration, trocar and cannula, or incision) followed by inflation by oxygen gas. Evacuation by the aspirator is usually inadequate owing to the frequent presence of large flakes of lymph, and it has been found better to use a large hydrocele trocar and cannula, after making a preliminary nick in the skin. In deeply situated abscesses evacuation by free incision commends itself. Evacuation is frequently facilitated by changing the position of the patient.

The apparatus required consists of oxygen in the usual cylinder, connected by tube to a wash-bottle containing hydrogen peroxide solution; this is connected in turn by a tube to a hydrocele cannula, or to a Potain's aspirator needle fitted with a two-way tap, which tap connects with the aspirator bottle and the suction syringe. Midway in the tube connecting the wash-bottle and the two-way tap is interposed a length of glass tubing containing a filter of sterile cotton-wool. This union and a coil of the rubber tube on either side lies in a basin of hot water to warm the gas.

The Procedure.

Rigid asepsis is essential; the aspirator or trocar should be introduced through sound skin, and if possible in such a manner as to produce a valvular closure on its withdrawal. If the abscess is evacuated by incision the needle or trocar for introduction of the gas may well be inserted at a distance from the incision, after the cavity is evacuated, and so arranged as to be in a convenient position. The incision is then closed, in layers if possible, before the gas is introduced. A similar procedure is applicable to the abdomen. Rost used flushing with saline or other fluids to aid in evacuation of large masses of lymph.

The abscess having been evacuated, or the abdomen

prepared for the introduction of gas by separation of adhesions, the oxygen is introduced through the cannula until a distension equal to that produced by the pus is obtained. In plastic tuberculous peritonitis the degree of distension is less easy to gauge, but it may be carried to the point of a tight distension, with a high tympanitic note on percussion; care must be taken to permit the patient to emerge from deep anaesthesia as the gas is being introduced, and, in order to avoid respiratory embarrassment, to regulate the flow of gas so that it is slow. Frequently only a small pocket, which may be in any part of the abdomen, may be attainable amongst the adhesions. Having once entered the abdomen, the line of least resistance is the line to follow; resistance to any but the gentlest pressure by the gloved finger should divert the efforts to another quadrant. A sponge on a holder, to reach a more distant point than the finger can reach, is dangerous, as at any point the easy yielding adhesion may be replaced by a dense one and the relatively non-sensitive pressure of the swab on a forceps, compared with the finger itself, may lead to a tear and a subsequent faecal fistula. The closure of the puncture is effected best of all by one or two Michel's clips. The purse-string suture used at first was found to be liable to produce necrosis of the edges of the puncture.

Selection of Cases.

Cases with sinuses or redness of the skin are not suitable. The presence of a mixed infection appears to lead to failure. So far tuberculous peritonitis with effusion has not yielded any good result. (See table, p. 907.)

Part Played by Oxygen.

A point of speculative interest is the part played by the oxygen. Rost suggests:

1. *Mechanical*, in separating the adherent surfaces by the pressure of the gas, and by preventing readhesion. We have observed that on the second or third inflation of a tuberculous abdomen the space amongst the adhesions had markedly increased (notably in case No. 2); we have noted also the cessation of vomiting after each inflation.
2. *Pressure* prevents exudation of fluid. (Limited observations do not confirm this, at any rate in regard to the abdomen.)
3. *Reduces blood supply.*
4. Pressure reduces pain by separation of joint surfaces. (To this we agree.)
5. Probably may exert some inhibitory action on the pathogenic process.

The chief interest lies in the possible inhibitory action of the oxygen on the tuberculous process. The tubercle bacillus is a fairly strict aerobe and does not, in the laboratory, grow under anaerobic conditions. Rost states that "The gas in passing through the wash-bottle is freed from any particles, and is rendered nascent." We have been unable to obtain any confirmation of this change taking place. Mr. C. R. Houseman, chief chemist to the British Oxygen Co., Ltd., has informed us "That cylinder oxygen after passage through hydrogen peroxide solution contains no trace of ozone, and is no more chemically active than before entering the solution; that no reaction occurs."

We may therefore seek for another explanation, and the work of MacLeod and Gordon,² of the pathological department of the University of Leeds, suggests another method of action. They find (1) that an inhibitory substance is developed in pneumococcal cultures to which there is abundant access of oxygen; (2) that this inhibitory substance is hydrogen peroxide; (3) that the early death of the pneumococcus in culture is usually due to accumulation of excess of hydrogen peroxide; (4) that in addition to pneumococci the only bacteria which have yet been shown to produce hydrogen peroxide are many streptococci, both haemolytic and non-haemolytic, and a few other coccal forms.

Another observation bearing on the question is that Pasteur made use of oxygenation to attenuate cultures of anthrax and of the virus of fowl cholera.³ Apparently, oxygen may have a deleterious effect on bacteria other than those capable of producing hydrogen peroxide.

* This article is based upon a paper read before the Nottingham Medico-Chirurgical Society.