

The Treatment of Diarrhoea in Infancy

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During 1941, there were 6644 deaths in Malta and Gozo including war casualties. Of these 1404, more than one fifth of the total mortality, were due to "diarrhoea and enteritis" and occurred in infants under two years. I do not think I need say anything more to emphasize the importance of the problem I have chosen for discussion.

The best treatment for the diarrhoeas of infancy is prevention. Diarrhoea as a major cause of infantile morbidity has disappeared from the statistics of most civilized countries, but prevention implies a series of measures which are beyond our immediate control — a safe milk supply, a higher standard of living, better education, etc. These are goals towards which we must all strive, both individually and collectively, but it will be years before they are attained. In the meantime, we must try to reduce the appalling mortality by improving our methods of treatment. The object of this paper is to outline a scheme of treatment which has given me satisfactory results, both in hospital and in private practice.

Diagnosis and Classification.

In severe diarrhoea, the stools are usually more than six in number and may be uncountable. They are watery. The temperature is raised. The child looks unmistakably ill. There is some degree of dehydration and the skin is dry, loose and inelastic. The fontanelle is depressed, the eyes are sunken and the nose looks pinched.

In fulminating cases the diarrhoea may not be a prominent feature but the toxæmia is very severe. Vomiting is a marked

characteristic. These cases are sometimes referred to as *cholera sicca*. The temperature may be very high or subnormal. The extremities are cyanosed and the facies recalls that of peritonitis.

Etiologically cases of diarrhoea may be divided into 4 groups, viz:

1. Diarrhoea due to Specific Microorganisms.

Diarrhoea caused by the dysentery bacilli, or by the *Entamoeba histolytica*, or by microorganisms of the enteric group. This type of diarrhoea is rare in babies under one year of age, and exceptional in those under six months, although lately cases of bacillary dysentery seem to be on the increase. This passage of small frequent stools containing blood and mucus and accompanied by considerable straining should raise the suspicion of dysentery at once. Examination of the stools is impracticable in most cases, but, if the diarrhoea does not respond at once to the treatment of bacillary dysentery, it is a good plan to have the stools examined for amoebae. Sometimes in older babies a prolonged mild diarrhoea is due to typhoid fever and it is wise to have the blood examined in any case of diarrhoea and fever which persists for more than one week.

2. Diarrhoea due to Parenteral Infections.

In progressive countries like Canada, the U.S.A., England and Holland, where epidemic and dietetic diarrhoeas have been eliminated almost completely, practically all cases belong to this group. Some paediatricians have gone to the length of asserting that infantile diarrhoea is due exclusively to otitis media and that pus

in the middle ear is the only constant finding in fatal cases. I used to think this view grossly exaggerated and inapplicable to Malta, but I have been convinced that this type of diarrhoea is just as common amongst us. The parenteral focus may be in the ear, in the throat, in the lungs, in the kidneys and even on the skin. Whenever a child suffering from diarrhoea is brought to you, you must look carefully into all these situations. Every physician who undertakes the treatment of babies must possess an otoscope and must know how to use it. Examination of the urine is equally important and an effort must be made to obtain a specimen in spite of the all but insurmountable difficulties. While on the subject of the examination of the patient, I should like to draw your attention to the advantages of taking the rectal temperature yourselves. The information given by the mother is often misleading and based on whether the baby feels hot or not. The temperature taken in the groin is equally unreliable. By taking the temperature yourselves you obtain information which is fundamental. At the same time the introduction of the thermometer into the rectum will often provoke the passage of a stool which you can examine in the fresh state. Thirdly, the introduction of the thermometer into the rectum will sometimes reveal an abnormal irritability of the nethermost portion of the intestine, a condition which often requires special treatment by starch enemata.

3. *Dyspeptic or Dietetic Diarrhoeas.*

These are very common in Malta owing to ignorance of the principles of infant feeding on the part of most mothers, and, I am afraid, of a number of doctors as well. Dietetic diarrhoeas are due to food which is unsuitable either as regards quantity or quality. The baby may be receiving too much or too little, the milk mixture may be too rich in carbohydrates,

or in fats, or unsuitable articles of food may have been introduced prematurely. It is impossible to enter into the details of infant feeding at this juncture; the subject is too wide and might form the subject of a separate lecture.

Clinically, dyspeptic diarrhoea starts as a mild enteritis and may persist as such for long periods. Occasionally it begins more violently but soon passes into the subacute or chronic state. The infant passes abnormal, green or curdy, but as a rule, not watery stools. There is no fever unless this is due to an intercurrent infection. The baby is fretful, unhappy and distressed but not desperately ill. The cardinal symptom is either failure to gain weight or an actual loss. The important point is that these infants are particularly liable to develop acute gastro-enteritis and to pass from this category into the next. The prognosis in these cases is much more serious than in cases of acute gastro-enteritis starting spontaneously. Treatment is also more difficult and unfortunately often ineffective.

Although the dietetic diarrhoeas generally run a mild, prolonged course there is one type — the fermentative carbohydrate diarrhoea — which may be very severe and accompanied by a sawed temperature. The differential diagnosis between this type of dietetic diarrhoea and acute gastro-enteritis is sometimes difficult. Some paediatricians would include most cases of acute gastro-enteritis under this heading. On the other hand others maintain that the fermentative diarrhoea is a chronic intestinal dyspepsia with an acute intestinal infection super-imposed. Although the distinction is sometimes difficult, I think that both types exist. The acute fermentative diarrhoea—sometimes called acute intestinal intoxication — is characterized by the passage of copious, highly acid watery stools accompanied by wind. The buttocks are sore, red and excoriated. Defaecation has an ex-

plosive character. Meteorism is marked. Dehydration is rapid and pronounced. The temperature rises as dehydration progresses and falls again as the lost fluid is replaced.

4. *Acute Gastro-Enteritis.*

This type of diarrhoea is known by a variety of expressive but confusing synonyms. It has been called infective or epidemic diarrhoea, cholera infantum, summer diarrhoea etc. There has been much controversy regarding its etiology and agreement has not been reached so far. At one time Morgan's bacillus was held to be the responsible microorganism, but this has not been confirmed. The dysentery bacilli, especially the Sonne bacillus has been incriminated, but, in spite of intensive research, it has been found impossible to find the casual agent. All the same, it is difficult to reconcile any hypothesis, which excludes infection, with the fact that the prevalence of summer diarrhoea has diminished in those places where flies and dust have been eliminated. Others claim that the diarrhoea is not due to an actual bacterial invasion of the intestinal tract but to toxins derived from contaminated and decomposing milk. All these factors may be operative and probably co-operative, but no one who has seen acute gastro-enteritis spread like wildfire in a children's ward will doubt that there is an infective element. It may be a microorganism as yet undiscovered, it may be a virus, it may be the *Bacillus coli* or an enterococcus whose virulence has been exalted; but there must be something which is carried from one baby to another by dirty bottles, dirty milk, dirty hands or by flies or by dust. The results that have been obtained quite recently through the use of sulphonamide derivatives seem to offer a confirmation of this view.

Treatment.

The first question that presents itself when treatment comes to be considered is whether the child should be sent to hospital. The answer is definitely — No! Infants as a rule do badly when they are sure to infect the other patients in the ward. If their diarrhoea is not infective, they will become infected themselves. Cases of diarrhoea treated in a general ward tend to relapse again and again and to end fatally in most instances. Hospitalization will be necessary in certain cases, but until infants can be treated in separate cubicles and have a nurse to themselves, treatment at home is preferable. A stupid mother is better than a trained nurse in these cases, since she can devote her whole time to her baby. This must not be taken as a reflection on the nursing staff. It is the opinion of all paediatricians all the world over. It is the duty of the physician to simplify his treatment as much as possible and to give clear, precise, foolproof instructions in writing. It is surprising what good nurses illiterate and harassed mothers can become when they are told exactly what to do.

The line of treatment to be adopted in each particular case depends (1) on the severity of the diarrhoea, (2) on the presence or absence of complications and (3) on the etiology. Treatment can be conveniently divided into two stages — the control of the diarrhoea in the first place, and secondly the reintroduction of food — the rehabilitation of the intestine. The second part is often more difficult than the first.

Treatment of Severe Diarrhoea.

I propose to deal with the treatment of severe cases of diarrhoea first. Here the picture is dominated by three major symptoms or complications: toxæmia,

dehydration, and acidosis. We know very little about the toxæmia which accompanies severe diarrhoea beyond the fact that it does exist and can be recognized as a clinical entity. It may be due to absorption of bacterial toxins from the intestines, to the entrance of the products of decomposition of milk, or it may be the clinical expression of dehydration and acidosis. We know however, that in acute gastro-enteritis, at least, the toxæmia is increased by the ingestion of milk of any kind. In the words of Dieulafoy "milk becomes a veritable poison" and the first principle in the treatment of severe diarrhoea is to exclude milk in any shape or form. Toxæmia is usually associated with a raised temperature and, as the estimation of the temperature is easier and less subject to personal bias than the estimation of toxæmia, I would enunciate the same principle in a different form viz:— In infantile diarrhoea do not give milk if the temperature is above 100° F. unless the fever is due to some other cause.

Dehydration is easily recognized. If there is an opportunity of weighing the baby, you will be surprised by the sudden and marked loss of weight amounting to between 20 and 40%. The skin is dry, loose, inelastic and when pinched up remains wrinkled. The eyes sink in and the cheek bones become prominent. The fontanelle is depressed. The cause of the dehydration is of course the loss of fluid and salt in the stools. In babies the reserve of fluid is small and the consequences of dehydration are serious and analogous in many ways to those of hæmorrhage and shock. They must be treated with equal promptitude. The fluid is at first withdrawn from the blood which becomes thick and viscous. This interferes seriously with the circulation. Hence the cyanosed extremities. Secondly the pre-renal deviation of water interferes with kidney function. The kidneys in a baby are not capable of concentrating the urine

to the same degree as in adults, and the diminution of available fluid soon leads to an accumulation of urea and other products of protein metabolism. At the same time acid radicles are not eliminated and acidosis is produced. The loss of water via the intestines interferes in a similar way with perspiration and the regulation of temperature. This is especially noticeable in summer. The result is a rapid rise in temperature quite independently of any infective agency.

Acidosis is intimately connected with dehydration and is a constant feature of severe diarrhoea. It has a threefold origin: the starvation entailed by diarrhoea leads to the breakdown of endogenous fat with the production of acid ketone bodies, the pre-renal deviation of water interferes with the elimination of acid radicles, which are retained, and the loss of large quantities of base (sodium) depletes the alkaline reserve when it is most urgently needed. When vomiting is more marked than diarrhoea, alkalosis may replace acidosis.

Dehydration can be combated by the administration of large quantities of water, but water by itself is not sufficient. It is not retained by the tissues. It is necessary to replace the sodium lost in the stools — hence the necessity of giving physiological saline in all cases of dehydration. As sodium chloride is not the only salt which is lost it would be more scientific to give a solution containing all the ingredients of plasma i.e. Ringer's solution. This, of course, should be done whenever possible, but it is more difficult to prepare and certainly more expensive than ordinary saline. As, in practice, saline gives equally satisfactory results it is not worth while complicating the treatment by insisting on the use of Ringer's solution. Again, the most scientific way of introducing this fluid would be to inject it slowly into the veins by the so-called drip method. The drip-method of saline in-

fusion gives excellent results, but it is not suitable for private practice. It is difficult enough in hospital practice. When persistent vomiting complicates the diarrhoea, or the baby is so ill that it refuses to drink, one is forced to give the fluid parenterally, by hypodermoclysis, or by intraperitoneal injection. Fortunately these cases are relatively rare and here an exception to the rule against hospitalization is permissible. But, in the majority of cases, babies will take physiological saline solution quite easily if it is diluted with an equal amount of water — the so-called “½ normal saline”. Even babies who are vomiting will usually keep it down. The treatment of dehydration therefore is the administration of normal saline—by mouth if possible, parenterally when one cannot do otherwise. Acidosis naturally suggests the use of an alkali — sodium bicarbonate or sodium citrate. But, in diarrhoea, the kidneys are not functioning properly and the range between acidosis and alkalosis in a baby is very small. Unless treatment can be controlled by frequent examinations of the blood the child can easily pass from one condition to the other without any recognizable clinical signs. *Prima facie*, sodium citrate might appear to possess the advantage of a diuretic action, but unfortunately it aggravates the diarrhoea. To obviate the very real dangers of alkalosis, Hartmann has proposed the use of sodium lactate which acts as a buffer, that is, it acts as a base if there is acidosis and as an acid if there is any tendency towards alkalosis. This sodium lactate may be added to Ringer's solution to form the so-called “Hartmann-Ringer's solution.” This would be the ideal solution to use but its preparation is difficult and beyond the competence of the ordinary pharmacist. The sodium lactate is produced by the interaction of lactic acid on sodium hydroxide in the solution itself and must be adjusted to a definite pH. In

practice I have found the use of a 10% solution of glucose in saline to give satisfactory results. The glucose provides a certain number of calories and eliminates ketosis, while the diuresis which follows its administration usually clears up the acidosis.

The third indication is to treat the cause. In the majority of cases severe diarrhoea is due to infective gastro-enteritis. In a smaller percentage of cases, it is due to parenteral infection and occasionally, it is due to carbohydrate fermentation. In cases of parenteral infection, as I have already said, the etiological treatment is the administration of sulphonamides. Lately it has been recognised that some of the sulphonamides, notably sulphapyridine and sulphaguanidine, are equally effective in cases of enteral infections, such as the bacillary dysenteries and infective diarrhoea. This has rendered the treatment of the acute stage of severe diarrhoea relatively easy. In my experience, sulphapyridine is more effective in infective diarrhoea than sulphaguanidine. Besides it has the advantage that it will also act in cases of diarrhoea due to a parenteral infection. In addition, it is more easily obtainable. I have therefore adopted Dagenan as the routine drug in the treatment of severe diarrhoea. Theoretically it should not act in cases of carbohydrate fermentation, and if you are sure that the diarrhoea is due to this cause, you should not use it. Starvation as a rule is sufficient in these cases. But the differential diagnosis is often difficult and I do not think that the giving of Dagenan in an unrecognized case of fermentative diarrhoea will do much harm. Of course this is very unscientific, but my advice would be to give Dagenan in all cases of severe diarrhoea accompanied by fever.

So much about the theory of the treatment. I am sure you will be more interested in the practical details. The routine I

have adopted after many experiments is as follows: Having made the diagnosis of severe diarrhoea with fever the mother is told not to give the child any milk or any other food. She is given a packet containing:—

Glucose 2½ ozs.
Sod. Chloride 90 grs.

and told to put this into a clean wine-bottle (25 ozs.) and to fill this up with boiled water. This will produce a 10% solution. She is to give two tablespoonfuls of warm boiled water every hour by day and by night. The advantage of giving the glucose saline as a powder instead of in solution, is that it is cheaper and reduces waiting at the chemist.

At the same time she is given a number of powders containing Dagenan. The effective dose seems to be relatively small, which is fortunate, considering the high cost of Dagenan. In babies under 3 months 1/6 of a tablet is usually sufficient. In babies from 3 to 6, I give ¼ tablet, from 6 to 9, 1/3 tablet and from 9 months upwards, ½ tablet. It is useless to tell the mother to break up the tablets herself. The chemist must prepare them. I prescribe them thus.

R/
Tab. Dagenan iv.
Divide in xvi chart.
S. One every four hours.

The mother is told to return next day. If diarrhoea and fever are still present the same treatment is persisted in and in most cases it is wiser to continue treatment for 48 hours. The only exception is in the case of emaciated infants where food must be started as soon as possible. If no impression has been made on the temperature and on the diarrhoea the dose of Dagenan may have to be doubled. In my experience however this is rarely necessary. In the great majority of cases the temperature is down to normal and the diarrhoea has ceased in from 36 to 48 hours.

The next stage is the re-introduction of milk. I do not propose to enter into a discussion on the relative merits of the various types of milk. Whenever breast milk is available it should be given preference — in other cases I use evaporated milk acidified with lactic acid. To proceed with the details of the treatment — if the mother was breastfeeding her infant, she should be advised to empty her breasts regularly every four hours with a breast pump while the baby is on the glucose saline. As soon as the temperature is down breast feeding is allowed for five minutes every four hours. As this does not provide enough fluid and enough nourishment glucose saline is continued in the intervals. If there is any sign of oedema, plain water or water and glucose is substituted. Waterlogging is rare but is apt to appear when the mother is too enthusiastic and gives more than the prescribed dose of saline. If diarrhoea reappears and the temperature goes up, one goes back to glucose saline for another day and tries again. If the stools are satisfactory the period of feeding is gradually increased until the baby is receiving its full share. In rare cases the mother's milk does not agree with the infant and then one must resort reluctantly to artificial feeding. The Dagenan is continued for another 4 days, making six days in all.

When the baby is fed artificially, I start with one table-spoonful of evaporated milk diluted with three tablespoons of water. To this, two drops of lactic acid are added and the mixture shaken well and allowed to stand for 5 minutes. It is a great advantage to show the mother the size of a table-spoon which is equivalent to ½ ounce as otherwise she is apt to use a desert spoon. I make it a point of showing the mother how to prepare the mixture using a suspension of creta preparata instead of milk, and plain water instead of lactic acid. This mixture is to be given four hourly. If the baby is able

to digest this milk, the dose is doubled in the next day and one goes on in this way until the baby is receiving the total quantity of fluid it should have for its age. The following table shows the dilutions which should be given progressively and a copy of it should be given to each mother. If she cannot read, there is sure to be a neighbour who will be willing to help her.

Days	Milk (tablespoons)	Lactic Acid Drops	Water (tablespoons)
I.	1.	2.	3.
II.	2.	4.	6.
III.	3.	6.	9.
IV.	4.	6.	12.
V.	5.	6.	11.
VI.	6.	6.	10.

In many cases one has to proceed more slowly and to keep the baby on the same quantity for three or four days before proceeding to the next stage. Again doubling the dose may be too much for the baby and it may be necessary to increase the dose more gradually starting with two teaspoons of milk and increasing by two teaspoonfuls daily. But if one went into these minute details in every case, the mother would get too confused and I have found that mothers introduce these modifications themselves without being told.

As in the case of breast feeding, in the initial stages the milk is supplemented with glucose saline and subsequently with plain water given in the intervals between feeds. The Dagenan is also continued for a total period of six days as already mentioned. No sugar is added until the stools are normal in appearance and not more than three per day. When this stage is reached one gives $\frac{1}{2}$ a teaspoonful of sugar with each feed and increases it to 1 teaspoonful if it is well tolerated. The lactic acid must be continued for at least 15 days and in many cases almost indefinitely. In older babies as soon as the stools

are satisfactory one can start semolina, rice, cereals and later eggs.

Such in brief is the routine treatment of severe diarrhoea that we have evolved after many experiments. The only advantage that I claim for it is its simplicity, and, of course, its effectiveness. Now and then, one will meet with a case that requires special treatment such as hypodermoclysis or a special kind of milk but you will be surprised at the rarity of these exceptions. With this treatment it is rarely necessary to stop milk for more than 24 to 36 hours.

Treatment of Mild Diarrhoea.

In mild diarrhoea there is no dehydration. Fever and toxæmia, if present, are due to a parenteral infection. If the parenteral infection is discovered, it should be treated at once and in most cases this will mean the administration of Dagenan. You must remember however that Dagenan is not effective if there is pus under pressure as in an empyema or a purulent otitis media, which is not draining well. In these cases surgical treatment is indicated. In mild diarrhoea due to parenteral infection there is no need to give purges or to starve the baby. There is no need to change the milk the baby has been having, but, as the digestive function of the infant is upset by infection, half the usual quantity of milk should be given.

In cases of mild diarrhoea of the dyspeptic type it is usual to start the treatment by giving an opening medicine to clear out the *materia peccans*. Castor oil is the best purgative to use and a teaspoonful is sufficient. Subsequently the baby is starved for twentyfour hours being given plain water or weak tea only. If the baby refuses these they may be flavoured with saccharine, $\frac{1}{2}$ a tablet to each four ounces. If the case is seen at the very beginning and is due to an obvious dietetic error this is usually all the treatment that is necessary. If the diarrhoea

has been going on for a long time, or if it tends to start again when milk is introduced the lactic acid treatment described before should be instituted. Sometimes these cases are very difficult to treat and require persistence, care, and patience.

There is really no place for drugs in the treatment of mild diarrhoea but occasionally a mixture containing 5 grs. of creta preparata to the drachm can be given, if the stools tend to remain loose.

There are two special types of diarrhoea that remain to be mentioned: ileo-colitis and proctitis. This is characterized by the frequent passage of small stools accompanied by much pain and straining. Mucus is constantly present, and blood is often present. Many of these cases are due to bacillary dysentery and respond well to the administration of Dagenan or Sulphaguanidine. Others have a non-specific origin and, in these, a mixture containing 5 minims of castor oil and $\frac{1}{2}$ a minim of opium given three or four times a day is often useful. If the case is resistant it is well to examine the stools for the *Entamoeba histolytica*. Although rare, cases of amoebic dysentery may occur in quite young infants. Carbarzone or Stovarsol $\frac{1}{3}$ to $\frac{1}{4}$ tablet given three times daily is a very effective remedy. The drug is given for 10 days and the course repeated after an interval of another 10 days.

Finally one last word on the treatment of what I have called "Proctitis". In this there is great irritation of the lower portions of the large intestines. The child resents the introduction of the thermometer into the rectum and pushes it out

by means of violent contractions. Small frequent stools sometimes consisting of mucus by itself are passed with great pain. An enema of 1 ounce of starch mucilage containing $\frac{1}{2}$ to 1 minim of tincture of opium twice daily seems to be the best treatment for these cases.

There are many treatments that I have not mentioned such as irrigations, Moro's apple diet, tannic acid preparations etc. All these have their special indications but years may pass before you meet with one of these cases. I have tried to be as practical and helpful as possible and to indicate the principles which should guide you in the treatment of the commoner types of diarrhoea. I should like to stress again the following points:

1. The frequency of diarrhoea of pararectal origin and the necessity of examining the baby thoroughly.

2. The possibility of typhoid fever, and of amoebic and bacillary dysentery as causes of infantile diarrhoea.

3. The necessity and advantages of taking the rectal temperature yourselves.

4. The almost specific action of Dagenan in infective gastro-enteritis.

5. The necessity of withholding milk while there is toxæmia and the temperature is raised.

6. The possibility of giving glucose-saline by mouth.

7. The advantages and the simplicity of preparation of lactic acid milk when Evaporated milk is used.

8. And, finally, the necessity of giving clear, written instructions to the mother and of demonstrating to her how the lactic acid milk should be prepared.

Postscript 1952.

In spite of the nine years that have passed since I wrote this paper, there is very little I would like to change. Morgan's bacillus has sunk into oblivion, for a time the *B. Coli comunis* var. *neapolitanus* stepped in its place, but we are still

ignorant as to the real cause of Epidemic Infantile Diarrhoea.

The principles of treatment I enunciated still hold good. Dagenan, of course, has disappeared and its place has been taken by sulphadiazine, which I now prefer to give as a suspension, the appropriate dose being made up to a teaspoon. I have had

no extensive experience with the new antibiotics but theoretically they should be able to do all that sulphadiazine does. The only obstacle is their cost and the difficulty of administration. I have seen two or three dramatic successes with Aureomycin given in the form of the spersoid. Terramycin as an elixir or as drops certainly deserves a trial and Chloromycetin in the form of the palmitate may prove to be the best drug of all.

I still believe that suitably diluted evaporated milk with lactic acid drops is cheaper and better than any proprietary brand of powdered acid milk and I still maintain that infants should be kept out of hospital as much as possible.

The paper was not intended as a scientific contribution but as a description of methods of treatment so simple that they would be intelligible to the meanest intel-

lect and applicable in the poorest household. It was a revolt against the traditional treatment of infantile diarrhoea with fractional doses of calomel and as such it may be considered as a milestone in local medical history. It is for this reason that I am glad it has been reprinted in its original form.

Nine years have passed. The infant mortality in Malta has dropped to what might be considered as quasi-European levels. No doubt this is due to a higher standard of living, to better education and to the influence of the Child Health Clinics, but in moments of depression I sometimes manage to cheer myself up by hoping that my paper might have contributed in some small measure towards this reduction.

J.E.D.