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Intraperitoneal Fluid Therapy in Cholera and Non-cholera Diarrhoea

With Special Emphasis on the Treatment of Infants and Children*

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Because of the relative difficulty in maintaining continuous intravenous infusions in small children suffering from cholera, a simpler method of maintenance fluid therapy would be useful. With this in mind, the role of intraperitoneal fluid administration was evaluated in 8 adults and 26 children (aged 6 years or less) having moderate to severe cholera or cholera-like diarrhoeal disease.

In adults intraperitoneal fluid was found to be of no significant value in maintenance therapy because peritoneal absorption was not sufficiently rapid to replace expected stool losses. In children, however, this form of therapy was considerably more successful. In 16 of 19 children with cholera and in all 7 with non-cholera diarrhoea, intraperitoneally administered fluid was absorbed rapidly enough to replace a major part of the initial fluid deficit on admission and all subsequent stool losses. No complications of intraperitoneal puncture were encountered.

Careful studies of water and electrolyte balances have provided the basis for rational and highly effective treatment of cholera both in adults (Watten et al., 1959) and in infants and children (Mahalanabis et al., 1970). The optimum replacement of fluid and electrolytes by the intravenous route combined with the administration of tetracycline by mouth reduces the mortality and morbidity in infants and children with clinically severe dehydration due to cholera to levels comparable to those in adults.[1] Because of the relative difficulty, however, of maintaining intravenous infusions in small children, a simpler method of fluid administration would be useful in the many cholera-affected areas where sufficient medical and paramedical personnel are lacking. This study was designed to explore the scope of a simpler route of fluid administration—intraperitoneal—in the treatment of cholera in infants and children.

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[1] Mahalanabis, D., Brayton, J. E., and Pierce, N. F.—unpublished observations.

Intraperitoneal fluid has been used for over 50 years as therapy in dehydrated children with diarrhoea in America and Africa (Blackfan & Maxcy, 1918; Carter, 1953; Huckstep, 1962).

Because the present knowledge of therapeutic responses in children with cholera was somewhat meagre, it was decided to determine first the therapeutic response to intraperitoneal fluid in adults, after which more extensive studies were done with children. This report summarizes our experience with the use of intraperitoneal fluids in both adults and children.

MATERIALS AND METHODS

Case selection and treatment procedures for adults

The present study involved 8 adult males admitted to the Infectious Diseases Hospital, Calcutta, with profuse watery diarrhoea of less than 24 hours' duration, with marked saline depletion and in shock (systolic blood pressure below 80 mm Hg); none had received prior therapy.

Initial therapy. In the first two patients studied (one of whom was bacteriologically negative for *Vibrio cholerae*) intraperitoneal fluids were given

early in the course of the illness to determine their efficacy in correcting initial saline depletion. In each patient intravenous therapy was given only for the first 30 minutes after admission, bringing the systolic blood pressure to above 90 mm Hg, but only partially correcting the saline depletion. The intravenous fluids were then discontinued and 2.0 litres of intraperitoneal fluids were rapidly administered. Thereafter, for the next 2 hours, vital signs were monitored every 30 minutes and the plasma specific gravity (PSG) was measured hourly.

Maintenance therapy. Seven patients (including the one vibrio-negative patient mentioned above) were subsequently studied to determine whether intraperitoneal fluids might be useful for maintenance therapy during cholera. In these patients normal hydration was restored and maintained with intravenous fluids until an accurate rate of stool output could be determined (usually within 6–10 hours of admission). At this time intravenous fluids were discontinued and intraperitoneal fluids (1.5 litres–2.5 litres) were given every 10–14 hours. Vital signs and stool volumes were measured hourly and the PSG every 4 hours. If the PSG increased to greater than 1.030, additional intravenous fluids were given.

Parenteral fluids. Fluids used for intraperitonea administration in adults were isotonic sodium chloride and sodium lactate in a 2 : 1 ratio with the addition of 5 mEq/l of potassium chloride. Fluids were given through a No. 18 needle into the left lower quadrant at a rate of approximately 100 ml per minute. Intravenous therapy consisted also of saline and lactate in a 2 : 1 ratio, but without additional potassium. None of these patients received antibiotics; only water was given by mouth.

Case selection and treatment procedures for children

Children aged 6 years or under, usually male, with a history of severe " rice-water " diarrhoea of less than 24 hours' duration, with moderate to severe dehydration at the time of admission to the Infectious Diseases Hospital, Calcutta, were chosen for study. After a brief history had been taken and a physical examination carried out, the child was weighed and placed on a metabolic bed. Blood from the femoral artery was collected in a heparin-rinsed syringe for immediate determination of pH, PSG and total CO_2 content. The plasma was frozen for subsequent determination of sodium, potassium, and chloride. Rehydration was promptly started according to the protocols described below.

Ringer's lactate solution was used for intraperitoneal administration. It was given from a bottle by gravity using an 18-gauge needle and a routine intravenous administration set. After preparation of the skin with iodine and alcohol, the needle was inserted in the midline 2 cm below the umbilicus and fluid was allowed to run at maximum speed. Ten to 15 minutes were usually required to administer 500 ml of fluid.

Dextrose (5%) in water was started by mouth as soon as patients tolerated oral fluid. This was given liberally, aiming to achieve a rate of approximately 120 ml per kg per 24 hours, thereby supplying free water requirements. Oral potassium was given at a rate of 4 mEq per kg per 24 hours in 4 divided doses in the form of an aqueous solution of potassium hydrogen citrate. Oral tetracycline was started 6 hours after admission at 50 mg per kg per 24 hours in 4 divided doses for 48 hours. Capillary blood was obtained hourly for the first 6 hours, then every 6 hours for determination of the PSG. Arterial blood was collected for determination of pH and total CO_2 at 12 hours, 24 hours and 48 hours after admission. Body-weight was determined every 6 hours thereafter in all patients.

Children's treatment groups

Group I (7 children). Rehydration in these patient was begun with intravenous Ringer's lactate solution at 20 ml per kg body-weight over the first hour, followed by an electrolyte solution containing sodium chloride and bicarbonate in 5% dextrose (composition: Na 106 mEq/l, Cl 74 mEq/l, HCO^-_3 32 mEq/l) at 30 ml per kg body-weight over the next 2 hours. Three hours from the onset of rehydration, intravenous fluids were stopped and Ringer's lactate solution was administered intraperitoneally, 50 ml per kg body-weight, thereby replacing 5% of the body-weight by the intravenous route and 5% intraperitoneally. Stool losses were measured at 6-hour intervals or earlier if indicated, and additional intraperitoneal fluids given in a volume equivalent to 75% of the measured stool loss.

Group II (9 children). Because of the satisfactory response of the patients in group I, an attempt was made in these patients to replace a larger portion of the initial fluid deficit by the intraperitoneal route. They were initially given Ringer's lactate solution intravenously (20 ml/kg–30 ml/kg) over 1 hour. Immediately after commencement of the intravenous infusion, intraperitoneal Ringer's lactate (60 ml/kg–70 ml/kg) was administered. All sub-

sequent diarrhoeal stool losses were replaced in the same way as for group I. Six children were successfully treated by this protocol, and are designated group II (*a*). Two "treatment failures" and one death among children treated by this protocol are designated group II (*b*).

Group III (3 children). These children, who had manifestations of moderate to severe dehydration but normal blood pressure, were not given intravenous fluid. The total estimated volume deficit on admission was replaced by intraperitoneal Ringer's lactate solution (70 ml/kg–100 ml/kg). All stool losses were replaced by intraperitoneal fluid in the same way as in the other two groups.

Group IV (7 children). Seven patients who were bacteriologically negative for *V. cholerae* were placed in this group; 5 of these were treated as for group II, 1 child as for group III, and 1 as for group I.

Analytical methods

The arterial pH was determined on anaerobically handled blood by a Radiometer pH meter 27 with capillary microelectrode. Plasma specific gravity was measured by a temperature-corrected refractometer (TS meter; American Optical Company). Plasma standard bicarbonate was measured by an Astrup Microtonometer or calculated from blood pH and plasma total CO_2 content measured by a Natelson microgasometer. Sodium and potassium were determined by a Patwin flame photometer with internal lithium standard. Chloride was determined by a Buchler–Cotlove chloridometer.

Bacteriological studies

Standard techniques described elsewhere (Sack et al., 1970) were used for isolation and identification of *V. cholerae* and other enteric pathogens. Stool samples were collected on admission by sterile rectal catheter. Thereafter daily samples were collected by rectal swabs.

RESULTS

Adults

Initial therapy. In neither of the 2 patients receiving intraperitoneal fluid as initial therapy was the saline depletion significantly corrected. The PSG remained abnormally high during the period of observation, and additional intravenous fluids were required to bring it to within the normal range.

Maintenance therapy. Intraperitoneal fluids were successful as maintenance therapy in 5 of 7 patients. A summary of the data from these 7 patients is given in Table 1. Stool output varied from 86 ml/h to 450 ml/h during the study periods. In the 2 patients with stool rates exceeding 400 ml/h, additional intravenous fluids were required to maintain normal hydration. In all other patients, stool output was below 200 ml/h, and adequate hydration was maintained with intraperitoneal fluids alone.

TABLE 1

SUMMARY OF INTRAPERITONEAL FLUID THERAPY IN 7 ADULT CHOLERA PATIENTS

Patient No.	Total stool output (l)	Duration of illness (h)	Rate of stool output (ml/h) during study	Duration of study (h)	Highest PSG [a] during study period	Total fluids given (l)	
						Intravenous	Intraperitoneal
967	18.3	117	191	88	1.029	8.5	14.5
984[b]	19.1	89	450 186	5 31	1.031 [c] 1.030	17.3	7.5
996	42.6	116	402	76	1.034 [c]	33.0	15.8
20	2.3	20	115	20	1.027	4.0	2.0
25	16.5	100	169	60	1.030	9.7	8.1
43	3.6	40	86	36	1.028	5.0	4.0
48	4.5	38	152	14	1.028	4.0	3.4

[a] PSG = plasma specific gravity.

[b] A second study was made in this patient after the stool rate had decreased.

[c] When plasma specific gravity rose to above 1.030 during the study period additional intravenous fluids were required.

Children

The 26 patients, divided into 4 groups as described, will be discussed separately. All patients in groups I, II and III had bacteriologically confirmed cholera. Of these 19 stool cultures positive on admission, 12 were Inaba and 7 Ogawa, all biotype El Tor, as determined by polymyxin-B resistance (Gan & Tjia, 1963). Of the 7 children negative for cholera, 1 harboured non-cholera vibrios of uncertain pathogenicity; no enteric pathogens were isolated from the remaining 6 patients.

Group I. Admission data and the course of illness for each patient are shown in Table 2. Their mean age was 3.4 years and mean duration of diarrhoea before admission was 9 hours. On admission an altered consciousness, low blood pH, low standard bicarbonate and elevated PSG were noted. Stool output over the first 12 hours ranged from 3.7 ml/kg/h to 7.3 ml/kg/h. Patient No. 5, who lost nearly 17% of his body-weight in 24 hours, required 4 separate intraperitoneal fluid administrations. Patients No. 2 and 4 needed 3 administrations each, and all the others either 1 or 2. All 7 patients recovered without complications and none required additional intravenous therapy after initial rehydration. All had an adequate oral intake of glucose water which ranged from 4% to 13% of their body-weight over the first 24 hours. Fig. 1 illustrates the course of illness in patient No. 5, who was successfully treated by this regime despite large losses of diarrhoeal stools. He lost about 600 g of watery stools during the first 6 hours which were replaced by 500 ml of intraperitoneal Ringer's lactate solution. Two more intraperitoneal administrations were required to replace his continuing stool losses during the first 24 hours.

Group II (a *and* b). Table 3 gives the relevant information on individual patients in this group. In group II (*a*) are 6 children who were successfully treated by this regime. The age and admission data are similar to those for the previous group. Stool output over the first 12 hours was less than in

TABLE 2

CLINICAL DATA FOR 7 MALE CHILDREN WITH CHOLERA, GROUP I

	Patient No.						
	1	2	3	4	5	6	7
Age (years)	3	3	2 7/12	3 6/12	2 11/12	5	4
Duration of diarrhoea prior to admission (h)	3	8	19	8	10	11	3
Findings on admission:							
Sensorium	Stupor	Drowsy	Drowsy	Coma	Drowsy	Drowsy	Alert
Loss of skin turgor (0 to + + +)	+ + +	+	+ +	+ +	+ + +	+ + +	0
Body-weight (kg)	8.57	9.43	7.58	11.37	9.40	10.24	10.07
Systolic blood pressure (mm Hg)	40	50	80	60	0	85	65
Blood pH	7.01	7.20	7.23	7.22	7.14	7.11	7.34
Plasma specific gravity	1.035	1.036	1.035	1.034	1.031	1.033	1.037
Standard bicarbonate (mEq/l)	9.5	9.4	11.1	12.8	13.6	10.8	16.6
Stool output (ml):							
0 h–24 h	041	666	394	989	1 573	685	1 056
24 h–48 h	88	291	360	0	647	0	0
Total intravenous fluid given (ml)	480	460	350	590	505	520	500
Total intraperitoneal fluid given (ml)	600	1 070	690	1000	1 840	1 080	1 330
Intake of oral glucose water over first 24 h (ml)	737	885	810	495	1 230	810	1 300

group I, ranging from 1.4 ml/kg/h to 6.2 ml/kg/h. Oral glucose intake over the first 24 hours was similar to that in group I, ranging from 7% to 15% of body-weight. One or two intraperitoneal administrations were necessary for each patient. Recovery was uneventful except in patient No. 2 who had transient signs of peritoneal irritation, i.e., guarding and rebound tenderness. Peritoneal fluid cultures were negative, however, and signs of irritation disappeared within 12 hours. Fig. 2 illustrates the course of illness over the first 24 hours in patient No. 1. He lost over 500 ml of diarrhoeal stools during the first 6 hours after admission, which were replaced by intraperitoneal Ringer's lactate solution. The child responded well, maintaining a normal blood pressure; his PSG and blood pH were normal at 6 hours and remained so thereafter.

Patients 1 and 2 in group II (*b*) represent treatment failures. Both had stool outputs over the first 12 hours considerably greater than the other 24 patients studied (9.4 ml/kg/h and 9.5 ml/kg/h) and each had a fall in blood pressure with deteriorating clinical signs, despite the administration of large volumes of intraperitoneal fluid. Both were given additional intravenous fluids and recovered uneventfully.

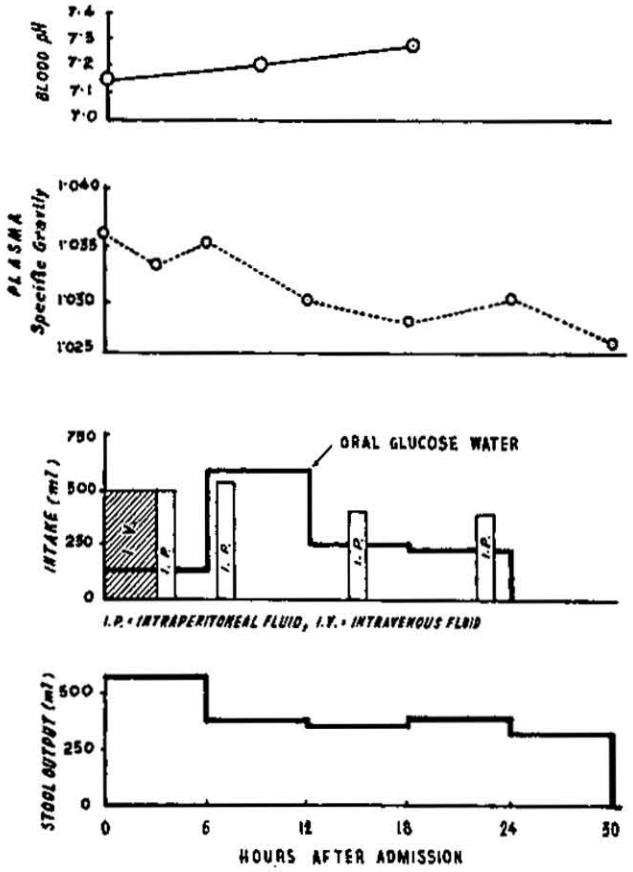
Fig. 3 demonstrates the course of illness in the first of these treatment failures. On admission he was given Ringer's lactate solution intravenously

TABLE 3

CLINICAL DATA FOR 9 CHILDREN WITH CHOLERA, GROUP II

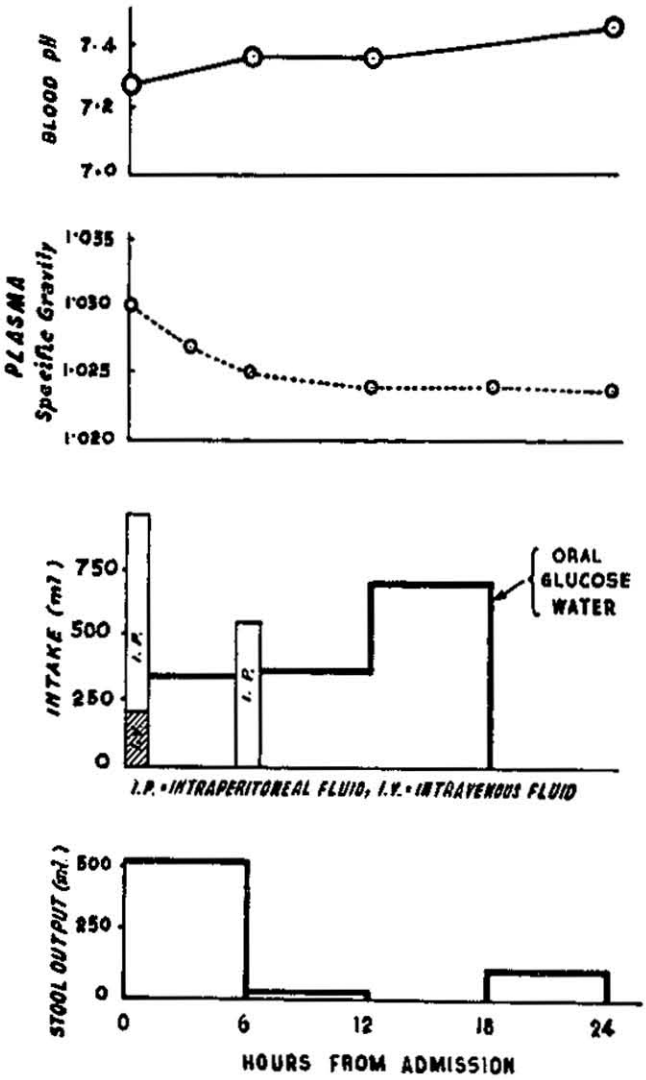
	Patient No.								
	Group II (a)						Group II (*b*)		
	1	2	3	4	5	6	1	2	3
Age (years)	3 6/12	6	2	2 6/12	2 6/12	3 6/12	5	4	3 6/12
Sex	M	M	F	F	F	M	F	M	F
Duration of diarrhoea prior to admission (h)	6	Not known	10	9	5	6	17	6	17
Findings on admission:									
Sensorium	Alert	Drowsy	Drowsy	Drowsy	Drowsy	Alert	Drowsy	Drowsy	Stupor; decerebrate
Loss of skin turgor (0 to + + +)	+ +	+ +	+ + +	+ + +	+ + +	+	+ +	+ + +	+ +
Body-weight (kg)	9.32	11.98	5.82	7.37	8.23	7.43	12.30	9.10	8.90
Systolic blood pressure (mm Hg)	90	40	0	55	50	80	75	45	0
Blood pH	7.28	7.21	7.03	7.24	7.21	7.33	7.13	7.13	7.20
Plasma specific gravity	1.030	1.037	1.037	1.036	1.034	1.030	1.033	1.039	1.033
Standard bicarbonate (mEq/l)	16.2	4.5	6.6	6.2	9.4	5.6	8.5	4.6	9.3
Stool output (ml):									
0 h–24 h	681	204	435	525	444	233	1 917	1 239	929
24 h–48 h	271	0	300	0	0	0	0	0	0
Total intravenous fluid given (ml)	200	250	150	210	250	150	2 270	1 290	700
Total intraperitoneal fluid given (ml)	1 290	1 080	740	940	540	540	1 620	1 080	1 260
Intake of oral glucose water over first 24 h (ml)	1 400	870	675	1 065	1 060	1 110	270	840	

FIG. 1
COURSE OF ILLNESS DURING THERAPY
IN PATIENT No. 5, GROUP I (9.4 kg) [a]



[a] After initial therapy he was maintained on intraperitoneal fluid alone, which was given in 4 separate administrations. Diarrhoeal stools over the first 24 hours amounted to 17% of his body-weight.

FIG. 2
COURSE OF ILLNESS DURING THERAPY
IN PATIENT No. 1, GROUP II (a) (9.32 kg) [a]



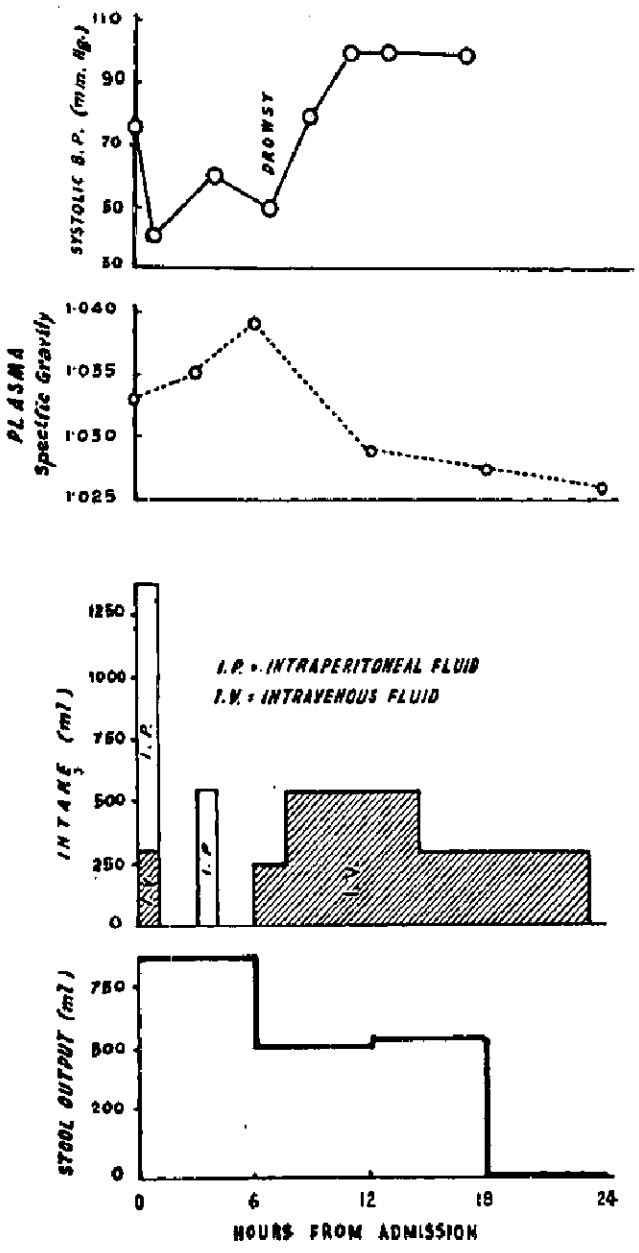
[a] The calculated fluid deficit on admission was replaced by Ringer's lactate solution, 20 ml/kg, over the first hour and 80 ml/kg Ringer's lactate solution intraperitoneally. Subsequent stool loss was replaced by a second intraperitoneal infusion.

(24 ml/kg) and intraperitoneally (88 ml/kg.) In spite of this, his general condition remained poor, his blood pressure dropped and his PSG increased. He was given another administration of 500 ml Ringer's lactate solution intraperitoneally although the first lot of intraperitoneal fluid did not appear to have been absorbed fully. During this time he continued to produce large volumes of diarrhoeal stools. After 6 hours he was given additional intravenous fluids and he thereafter made an uneventful recovery.

The third patient in group II (*b*) died 24 hours after admission. However, her death was considered unrelated to the fluid therapy. On admission, this child was in shock, gasping and unresponsive. Blood pressure was corrected within 25 minutes of admission with intravenous Ringer's lactate solution and remained normal thereafter. Intraperitoneal fluids (80 ml/kg) were given at this time. Within 2 hours of admission and without ever regaining consciousness, the patient developed decerebrate posturing and tonic–clonic seizures. Oral fluids were thought to be contra-indicated and the child was removed from the study and given intravenous replacement therapy only. Examination of cerebrospinal fluid was normal and CSF cultures were sterile. Despite anticonvulsants, intravenous calcium gluconate and dextrose, the child's seizures could not be adequately controlled and she died suddenly 24 hours after admission. Permission for autopsy was not granted.

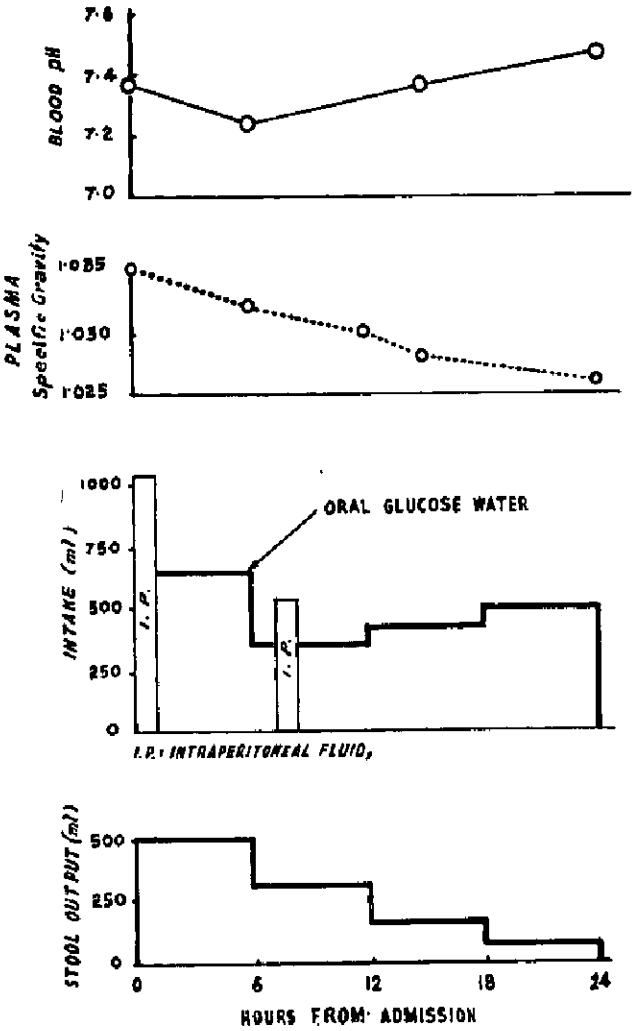
Group III. Data from these 3 patients are given in Table 4. On admission each had an adequate systolic blood pressure, but marked base deficit and

FIG. 3
COURSE OF ILLNESS DURING THERAPY
IN PATIENT No. 1, GROUP II (b) (12.3 kg) [a]



[a] Admission deficits were replaced by Ringer's lactate solution, 24 ml/kg intravenously and 88 ml/kg intraperitoneally. In spite of this, his general condition remained poor, blood pressure dropped, and plasma specific gravity rose. His condition did not improve despite a second intraperitoneal infusion, and at 6 hours, he was started on intravenous fluids. He thereafter made an uneventful recovery.

FIG. 4
COURSE OF ILLNESS DURING THERAPY
IN PATIENT No. 3, GROUP III (12.47 kg) [a]



[a] This patient was normotensive on admission, although moderately severely dehydrated. He was given only intraperitoneal Ringer's lactate solution, approximately 80 ml/kg, to correct initial deficits. Subsequent stool loss was replaced by a second intraperitoneal infusion.

elevated PSG. Stool output over the first 12 hours ranged from 1.2 ml/kg/h to 5.6 ml/kg/h. Each had an adequate oral intake of glucose water, ranging from 12% to 15% of body-weight in 24 hours. Recovery in each was uneventful. The course of illness in patient No. 3 is illustrated in Fig. 4. On admission, this child was not in shock but had moderately severe dehydration and metabolic acidosis, as evidenced by loss of skin turgor, high PSG and low plasma standard bicarbonate. He was given intraperitoneal Ringer's lactate solution (approximately 80 ml/kg) to replace the initial deficit. Stool loss during the first 6 hours was replaced by a second administration of intraperitoneal fluid 7 hours after admission. His clinical response was satisfactory; the PSG and blood pH gradually returned to normal.

Group IV. Results from these 7 patients, who had a severe cholera-like illness in spite of vibrio-negative stool cultures, are summarized in Table 5. The severity of illness is comparable to that in the

TABLE 4
CLINICAL DATA FOR 3 MALE CHILDREN WITH CHOLERA, GROUP III

	Patient No.		
	1	2	3
Age (years)	2 1/12	2 6/12	4
Duration of diarrhoea prior to admission (h)	24	7	7
Findings on admission:			
Sensorium	Alert	Alert	Drowsy
Loss of skin turgor (0 to + + +)	+ +	0	+
Body-weight (kg)	6.88	9.875	12.47
Systolic blood pressure (mm Hg)	80	90	85
Blood pH	7.29	7.20	7.37
Plasma specific gravity	1.029	1.036	1.035
Standard bicarbonate (mEq/l)	10.6	7.7	10.6
Stool output (ml):			
0 h–24 h	98	566	1 212
24 h–48 h	0	70	8
Total intravenous fluid given (ml)	0	0	0
Total intraperitoneal fluid given (ml)	540	1 380	1 680
Intake of oral glucose water over first 24 h (ml)	855	1 450	1 890

patients with cholera. Many of them passed large amounts of stools—between 1.1 ml/kg/h and 7.4 ml/kg/h during the first 12 hours. The treatment responses in each of them were satisfactory; no additional intravenous fluids were necessary.

The rapid administration of 70 ml–80 ml of intraperitoneal fluid per kg of body-weight did not cause any discomfort or respiratory embarrassment to any child. Transient signs of peritoneal irritation in one child, as described, were not regarded as being of major significance.

DISCUSSION

Adults

Because of the slow rate of absorption, the administration of intraperitoneal fluid is unlikely to be of any significant value in initial rehydration of adult cholera patients. After the initial deficit has been corrected by intravenous fluids, however, adequate hydration can be maintained by intraperitoneal infusion, provided that the rate of stool output does not exceed approximately 200 ml/h. Since the majority of cholera patients have stool rates considerably greater than this, intraperitoneal therapy has little or no practical usefulness in adults.

Children

Intraperitoneal fluid and electrolyte administration in children, however, was found to be a simple, safe and effective method for partial initial rehydration and replacement of concurrent stool losses in the majority of patients. In 16 of 19 children with proven cholera and in all 7 with non-cholera diarrhoea, intraperitoneal fluid was absorbed rapidly enough to replace a major part of the initial deficit on admission and all subsequent stool loss. In all 23 successfully treated patients, the blood pressure remained normal after the first hour of therapy, the general clinical state steadily improved and most patients were eating a regular diet after 24 hours.

Three children (group III) who had moderate to

TABLE 5

CLINICAL DATA FOR 7 MALE CHILDREN WITH SEVERE NON-CHOLERA DIARRHOEA, GROUP IV [a]

	Patient No.						
	1	2	3	4	5	6 [a]	7 [a]
Age (years)	2 1/12	3	1 4/12	7/12	3 10/12	11/12	3
Duration of diarrhoea prior to admission (h)	5	24	21	12	11	18	6
Findings on admission:							
Sensorium	Coma	Alert	Drowsy	Drowsy	Alert	Drowsy	Drowsy
Loss of skin turgor (0 to + + +)	+ +	+	+ +	+ +	+ +	+	+ + +
Body-weight (kg)	10.315	7.820	7.08	3.90	9.32	7.64	9.117
Systolic blood pressure (mm Hg)	48	75	65	85	75	90	20
Blood pH	7.12	7.17	7.17	7.23	7.23	7.21	7.17
Plasma specific gravity	1.032	1.028	1.032	1.024	1.035	1.028	1.030
Standard bicarbonate (mEq/l)	10.6	9.8	11.8	4.35	6.2	6.27	4.8
Stool output (ml)							
0 h–24 h	208	942	330	240	698	487	0
24 h–48 h	0	50	120	170	0	32	0
Total intravenous fluid given (ml)	280	210	150	100	270	0	450
Total intraperitoneal fluid given (ml)	540	1 080	540	350	1 040	540	540
Intake of oral glucose water over first 24 h (ml)	570	810	825	1 065	1 080	1 080	1 065

[a] All treated as for group II, except patient No. 7, who was treated as for group I, and Patient No. 6, treated as for group III.

severe dehydration but who had no associated hypotension were successfully rehydrated with intraperitoneal fluid alone. Two of these passed considerable volumes of diarrhoeal stools after admission. On the basis of this small experience, it would appear that rehydration can be effected by intraperitoneal fluid alone, if treatment is given before the onset of hypovolaemic shock.

Two failures in the study point to the basic limitation of intraperitoneal fluid therapy. The rate of stool loss may be greater than the rate of effective fluid absorption, so that normal hydration cannot be maintained. These two children had the highest rates of stool loss among the 26 study patients (9.4 ml/kg/h–9.5 ml/kg/h over the first 12 hours after admission). It would appear—although this was not directly measured—that stool rates below about 8 ml/kg/h can be successfully replaced by intraperitoneal fluids alone, whereas those above this value exceed the capacity for intraperitoneal absorption.

Ringer's lactate solution, which was used as maintenance replacement fluid, has a 25% higher sodium concentration than the mean concentration of sodium in children's cholera stools (Mahalanabis et al., 1970). Therefore, only 75% of the stool output was replaced by intraperitoneal Ringer's lactate solution. The resultant water deficit, in addition to obligatory water loss through the lungs and kidneys, was met by the liberal intake of oral glucose water. It is possible that the large quantities of glucose water given by mouth may have influenced the reabsorption of sodium within the small bowel, and therefore may have contributed to the therapeutic results. Plans to study this possibility in more detail are contemplated.

Maintaining intravenous infusions over any length of time in small children requires skilled personnel, specialized equipment and expert supervision. Moreover, if proper facilities and supervision are not available, overhydration can easily occur in a small child. Both of these difficulties can be largely over-

come if the majority of children in a cholera ward could be maintained on intraperitoneal fluid therapy.

The safety of this method, as previously shown in children with infantile diarrhoea (Blackfan & Maxcy, 1918; Carter, 1953; Huckstep, 1962; Ransome-Kuti et al., 1969), has been confirmed in children with cholera. The need for aseptic precautions and for using sterile pyrogen-free infusion fluid and administration sets, however, should be emphasized, since the potential problem of intraperitoneal bacterial infection is always present. These and other complications, such as bladder or bowel perforation, however, have been rare, even under the most primitive of conditions (Carter, 1953; Huckstep, 1962).

There is no substitute for the prompt administration of intravenous fluids to combat hypovolaemic shock associated with severe dehydration in children with cholera. Intraperitoneal fluids are not recommended for initial treatment in patients with hypotension, owing to the variable peritoneal absorption associated with decreased mesenteric blood flow. Once hypotension is corrected, however, intraperitoneal fluid may be a useful additional or alternative means of replacing a major proportion of the initial fluid deficits and the entire subsequent stool output during recovery.

RÉSUMÉ

ADMINISTRATION DE LIQUIDE PAR VOIE INTRAPÉRITONÉALE DANS LE TRAITEMENT DU CHOLÉRA ET DE LA DIARRHÉE GRAVE D'ORIGINE NON CHOLÉRIQUE, SPÉCIALEMENT CHEZ LES NOURRISSONS ET LES JEUNES ENFANTS

L'administration prolongée de liquide par voie intraveineuse chez les jeunes enfants atteint de choléra ne va pas sans poser certains problèmes surtout dans les régions où les effectifs du personnel médical et paramédical sont insuffisants et où une méthode plus simple de réhydratation serait appréciée.

On a étudié la possibilité de recourir à l'injection intrapéritonéale de liquide pour compenser les pertes d'eau et d'électrolytes chez 8 adultes et chez 26 enfants âgés de moins de 6 ans, atteints d'une forme moyenne ou grave de choléra ou d'une affection diarrhéique cholériforme. Les adultes ont reçu une solution isotonique de chlorure de sodium et de lactate de sodium, additionnée de 5 mEq/litre de chlorure de potassium, et les enfants la solution lactée de Ringer.

Chez les adultes, l'administration intrapéritonéale de liquide de remplacement n'apparaît pas comme un mode acceptable de thérapeutique d'entretien, l'absorption, trop lente, ne permettant pas de compenser les pertes de liquides dans les selles. En revanche, chez les enfants, cette forme de réhydratation s'est révélée beaucoup plus efficace. Chez 16 des 19 enfants atteints de choléra et chez les 7 enfants souffrant de diarrhée cholériforme, le liquide introduit par voie intrapéritonéale a été résorbé suffisamment rapidement pour pallier la plus grande partie du déficit en liquide présent au moment de l'admission et les pertes ultérieures. Trois jeunes cholériques qui présentaient un syndrome de déshydratation relativement grave, mais sans hypotension artérielle associée, ont été réhydratés avec succès grâce à la seule administration de liquide par voie intrapéritonéale. Par contre, ce traitement n'a pu assurer un équilibre normal chez 2 enfants, le rythme d'évacuation des liquides dans les selles, atteignant respectivement 9,4 et 9,5 millilitres par kilo et par heure pendant les 12 premières heures, étant trop rapide. Dans ces deux cas, il a été nécessaire d'appliquer en outre la réhydratation par voie intraveineuse. Un décès, sans relation apparente avec les modalités du traitement, a été enregistré parmi les enfants. L'utilisation de la voie intrapéritonéale n'a donné lieu à aucune complication.

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