THE TREATMENT OF MILK IN INFANTILE GASTRO-ENTERITIS

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'Curds and honey shall he eat . . . . . ' *Isaiah*, ch. 7, v. 15.

The title of this paper is not a misnomer. Time was when the treatment of gastro-enteritis was mainly concerned with the alterations in the composition of milk feeds, the affected infant taking second place; but latterly, with the increase in understanding of the profound biochemical changes occurring in gastro-enteritis, attention is being concentrated on the affected infant, and the make-up of the formula is now of secondary interest, as is also the frequency and character of the stools. The quaint practices of earlier days are giving way to more exact and scientific handling of the affected infant. The era of the 'stool-gazers',[1] 'clinical soothsayers' and 'formula fiddlers'[2] is rapidly passing, but is not yet quite over, and it will be profitable to consider how it came about that in infantile gastro-enteritis treatment was directed to the milk rather than the infant, and how our ideas on this subject have changed.

MILK IN GASTRO-ENTERITIS

The spectre of Czerny's 'Milchnahrschaden' (milk injury)[3a] still haunts the portals of paediatric instruction. All too frequently cow's milk is looked on as the cause of diarrhoea—a concept still being accepted by students, nurses and residents. Any raw novice to paediatrics, when confronted with a child having diarrhoea, is pretty certain to order diluted feeds without knowing why this should, or should not, be done. 'Put him on clear fluids for 24 hours' is almost an axiom of paediatric therapy. Early paediatric teaching and internship training leaves hard-to-erase impressions in the trainee's mind. It is difficult to unlearn errors and to question accepted dogma. Nurses automatically give ½- or ¼-strength feeds if a child passes a loose stool.[4] Even most of the 'intelligent' public 'know' that milk is bad for diarrhoea, and that the fat in the milk is especially noxious. When an infant has a few loose stools it is quite the rule for the mother to ask: 'Must I stop his milk?'

Time was when physicians not only fiddled and juggled about with the formula, but also changed it on the basis of the appearance of the stool. Today most physicians are content to deal with glucose or sugared water, ¼-, ½-, or full-strength feeds; while some—a small minority—are even impatient with this conception, believing that milk modification and dilution make no material difference to the course of diarrhoea, and, if anything, infants given full feeds (plus adequate extra fluids) do better than those who suffer ¼, ½, or full iatrogenic starvation.

Historical Survey

The ancient Babylonians[5] wrote on diarrhoea, and on the medications and incantations necessary for its cure. Cholera infantum was described by Areteus, and by Rhazes;[6] and Thomas Phaer indicted teething as its cause—a view first suggested by Hippocrates.[7]

Geronimo Soriano,[8] a Spanish physician, wrote a book on diseases of children (1600) in which he advised starvation treatment for diarrhoea. A century later Underwood[9] also substituted broth for milk when the bowels were loose. Now, while the period of the Renaissance was one of general enlightenment, there was little, if any, enlightenment in the field of infant feeding. The period was marked by a massive increase in hand (artificial) feeding and in bad wet-nursing. As a result, infantile gastro-enteritis was rife and deadly. It was common knowledge that infants who were breast-fed by their mothers seldom became ill with the 'watery gripes', but that the hand-fed infants rapidly succumbed to it. The blame was laid at the door of the common denominator—animal's milk—and correctly so; until recent years, with the widespread practice of pasteurization, animal's milk remained foul and filthy.

Consequently there were determined efforts to rear artificially fed infants on food other than cow's milk—which resulted in the common use of pap and panada: cereals cooked in milk-free fluids. The outcome of such attempts at infant rearing was also catastrophic. If it should have happened that a baby was being fed partially on animal's milk, and then developed diarrhoea, certainly the milk was removed, being considered poisonous, as indeed it probably was in so far as it might have been the vehicle for the spread of gastro-enteritis.

By the 1800's, when Western paediatrics entered the modern and rational phase, animal's milk was known to be associated with diarrhoea and was roundly condemned by the physicians of the day as being poisonous to infants having loose stools.

Why it should have been poisonous was not fully appreciated until 100 years later, and this period of a century marks the gradual evolution of thought on the hazards of cow's milk in gastro-enteritis. Initially the opinion was held that various chemical and physical constituents (curds) of the milk were responsible for producing diarrhoea, toxicosis, dyspepsia, athrepsia, decomposition, intolerance, indigestion, and intoxication. At the present time there are more substantiated views on the bacteriology and virology of diarrhoea, on the chemistry and osmolarity of cow's milk, and on body fluids and renal function.

Before 1900 it was milk *per se*, even breast milk, that was condemned as being poisonous in diarrhoea. Cheadle,[10] of the Westminster Hospital, had stated this, and Eustace Smith[11] had written: '. . . the treatment consists mainly in the careful regulation of the food. Milk in such a case is an irritant which must be strictly forbidden'.

After the turn of the century there arose the view that it was not milk *per se* that was hazardous, but only certain constituents of it. Such theories had even been mooted before 1900, when Biedert[3b] wrote that the casein of milk might be dangerous in diarrhoea, though he also had his reservations about fat. Escherich,[3c] while engaged on monumental studies on intestinal bacteria, still toyed with the possibility of carbohydrate fermentation and protein putrefaction in the bowel as causes of diarrhoea. However, it was only after 1900 that a great impetus was given to bowel 'dyspepsias' by Czerny,[3a] who blamed fat; by Finkelstein,[3d] who incriminated carbohydrate and milk electrolytes, and by Rotch,[12] who, like Biedert, noted that cow's milk had more protein than breast milk, and decided that milk protein was at fault.

Diarrhoea, being thought to be of dietetic origin, was treated by dietetic means. If a physician considered that one or other milk factor was at fault, then such constituent was reduced or replaced by another. All too often, all the milk constituents were incriminated, so that milk intake was severely curtailed by gross and long-standing dilution. When there was no response to this treatment, numerous modifications of milk were tried, and, as Marriott[13] later stated, 'any success which attended such efforts was usually to be attributed to the accidental giving of a sufficient amount of food'.

The principal physicians who possessed the esoteric knowledge of the cult of milk modification—largely based on 'stool-gazing'—were the three 'high priests' of the 1900s, Czerny,[3a] Finkelstein,[3d] and Truby King.[14] King was such a devoted believer in the evil propensities of milk that he even forbade breast milk in the presence of diarrhoea, and his influence, like that of his cohorts, spanned the world, and is still readily discernible today—especially among the laity, for whom the whole subject of infant feeding is still befogged in mysticism. Fischer,[15] in America, wrote two volumes on paediatrics (1928) and devoted a whole chapter to 'milk poisoning' complete with a photograph of such a case (a child with undernutrition and dehydration). Even Griffith[16] (the first 'Mitchell-Nelson') in his two volumes, reserved a paragraph for 'acute milk poisoning', though mercifully there is no illustration of such a condition. In England, Eric Pritchard was content to give no food whatever for 24 hours. He knew of the work of DuBois and Coleman (1912) which showed that in typhoid enteritis digestion and assimilation of food was almost normal, yet he wrote: 'I am quite unconvinced . . . and I still pin my faith to the method of low caloric feeding . . .'.[17]

Protein Milk

In keeping with his views that diarrhoea was caused by excessive fermentation of sugars within the bowel, Finkelstein[3d] devised his famous 'protein milk' (albumin milk, Eiweissmilch) in which the sugar was especially low, as was also the content of sodium and potassium. He reasoned that the fatty acids in the digested milk would then combine with the insoluble electrolytes (calcium and

magnesium) to form insoluble soaps and thus give bulk to the stools.[18] Protein milk was poorly named, for the percentage of protein in it was only 3% (fats 2·5%, sugar 1·5%, salts 0·5%) and the caloric value about 14 calories per oz. Despite a most complicated method of preparation, it became popular in America and was widely used for two decades; it is still in extensive use in southern Ontario.

Grulee,[19] Hill,[20] and Fischer[15] were most excited about the virtues of protein milk, and Brennemann[21] was lavish in his praise, as was Holt senior.[22] 'Casein is therefore indicated to combat diarrhoea', wrote Fischer, 'this teaching . . . reverses our former theories . . .'.[15] Grulee said: 'In decomposition . . . no artificial food can compare . . . with Finkelstein's and Meyer's albumin milk.'[19]

However, Morse[23] was not too enthusiastic about protein milk, and in England it did not become popular. Pritchard[17] heaped scorn on it: 'Personally, I agree with no part of the argument, and I regard Eiweissmilch as a very clumsy and complicated method of providing a mixture of the desired properties'.

Modified Milk

Concurrent with the widespread use of protein milk, and following it, milk was also modified in other respects, largely as a consequence of Czerny's imprecations against fat. Skimmed milk came into common use, also lactic-acid milk, and humanized milks, in particular the SMA (Synthetic Milk Adapted) of Gerstenberger.[24a,b]

The use of one or other modified milk in the treatment of gastro-enteritis has persisted until now, and the well-known doctors who advised such milk modification are too numerous to list, but among those who have diluted milk, humanized milk, replaced its sugars with dextrins, defatted milk, acidified milk or otherwise altered and emasculated it, there must be mentioned such authoritative names as Rotch,[12] Morse,[23] Czerny,[3a] Finkelstein,[3d] Truby King,[14] Hill,[20] Hess,[25] Still,[26] Griffith,[16] Holt snr.,[22] Grulee,[19] Pritchard,[17] Spence and Miller,[27] Brennemann,[21] Watkins and Paterson,[27] Paterson and Newns,[28] Jeans and Marriott,[13] Sheldon,[29] Slobody,[30] Spock,[31] Darrow,[32] Cooke,[33b] and Finberg.[34]

Even the more modern among these have assiduously pursued the path of the earlier masters. In the 1941 edition of their book, Jeans and Marriott[13a] gave consideration to the part played by fermentation of sugar in the causation of diarrhoea. In the 1947 edition[13b] this discussion was omitted, and a note was made that viruses may be responsible for epidemic diarrhoea of the newborn. In the 1955 edition of his book, Sheldon[29] wrote extensively on 'indigestion' and the various milk constituents which are alleged to cause such bowel disorders. The booklet 'Canadian Mother and Child', official publication of the Canadian Department of Health and Welfare[35] repeated the fiction about sugar and fat causing diarrhoea: 'If sugar is causing the trouble, definite signs and symptoms will appear. The baby will be restless, cry spasmodically, move its legs jerkily; usually the abdomen will be distended and tender to touch. The stools will be loose, frothy, sour smelling and irritating . . .'. 'If fat is at fault . . . the child may develop diarrhoea . . .'.[35]

The widely read and enormously influential Spock[31] advised that, in mild diarrhoea, diluted skimmed milk is the nutrient of choice, and that in serious diarrhoea all milk is forbidden for 24-72 hours 'depending on how soon the bowel movements improve in appearance'. (What an odd criterion for oral management!) 'Then proceed *very* gradually.' *The Complete Book of Mothercraft* agrees with this view.[36] Parsons and Barling,[27] Herweg *et al.*,[37] and Ebbs[38] repeat the usual advice about diluting milk and proceeding very slowly thereafter to full feeds. Mann *et al.*[39] deal extensively with the necessity for regrading of feeds and note that most patients take as long as 8-14 days to resume full feeds. Virtually all among the aforementioned stress the need for redilution of milk if there is a relapse of diarrhoea.

Darrow,[32] Cooke[33b] and also Finberg[34] advise prolonged dilution of feeds, but for different reasons entirely, reasons which will be considered presently.

Heresies

However, during the past half-century of the practice of milk modification in diarrhoea, there have been a number of heretics who have struggled against the flood of modified and diluted milk.

At the turn of the century, Pierre Constant Budin,[40] a remarkable Frenchman, noted that undiluted sterilized cow's milk markedly benefited infants with wasting and diarrhoea. Much later Hess[25] warned against prolonged initial starvation in the treatment of diarrhoea, and Jeans and Marriott,[13] while subscribing to the usual treatment by means of diluted skimmed milk, did make the observation that such feeding has no obvious beneficial effect in the diarrhoea of bacillary dysentery: 'In bacillary dysentery . . . starvation, even if prolonged, is likely to have but little effect in causing a cessation of the diarrhoea'.

Goldbloom[41] evidently had little fear of fat and advised that it be added to the commonly used skimmed milk in the treatment of diarrhoea. He wrote: 'The consistency of the stools depends on saponification of fat, and you cannot make soap without fat any more than you can make bricks without straw'.[18]

Chung[42] considered that relapses of diarrhoea resulted from the vagaries of the disease, and not from oral food and fluid load. Lanman[43] doubted that any particular milk had especial virtues in the management of gastro-enteritis, so did Karelitz;[44] and Mitchell[45] introduced milk feeding very early in the treatment of diarrhoea. Young and Rogers,[46] in writing 17 pages on 'Recent advances in gastro-enteritis' managed to avoid the mention of feeding at all!

Dean and Weinbren[47] found fat quite innocuous. They administered it to infants with kwashiorkor. I have also had the opportunity of giving 1½ oz. of cream daily to some six children with kwashiorkor and diarrhoea without ill effects. Chung and Viscorova[48] did elegant balance studies to indicate that food and fluid absorption in diarrhoea is directly proportional to the food and fluid intake, notwithstanding the increase in bowel contents, for this increase is of little consequence; what is important is the food and fluid absorbed and utilized.

Holt and MacIntosh[49] considered that in the treatment of mild diarrhoea there is no need to change the diet in any respect—though fluid intake should be increased. Holt,[49] and Moncrieff and Evans,[50] while repeating the usual details of milk modification and dilution in diarrhoea, were nevertheless not entirely convinced, for they did mention the work of Chung and Holt,[42] and suggested 'feeding a diarrhoea' as an alternative means of management. The 1954 edition of Nelson[33a] adopted the same neutral stand, but in the 1959 edition the relevant section was written by Cooke, who made it clear, in a few short sentences, that he disapproved of Chung's views.[33b]

A New Emphasis

Here the scene changes, however, and shifts from intestine to kidney. Milk dilution and modification has effects not only on the alimentary apparatus, but also on the excretory organs; and having established, as is now reasonably clear, that virtually all foodstuffs, including undiluted cow's milk, are well tolerated by the intestine, even when inflamed, it is now questioned whether these same foodstuffs are equally well tolerated by the kidney.

Among those who wrote on milk modification in gastro-enteritis, the more recent authors have been paying attention to renal function, so that over the past half-century there has been a gradual and subtle shift of emphasis from digestive intolerance to renal intolerance, and from the composition of milk to alterations in the composition of body fluids consequent on diarrhoea.

Light has also been thrown on the problem by advances in bacteriology and virology. Nowadays very little is heard in medical circles (though a great deal in lay and even nursing circles) concerning milk constituents as causative factors in diarrhoea. Instead, increasing attention is being paid to the rôle of micro-organisms in gastro-enteritis.

The rôle of salmonella, shigella and staphylococci as causes of gastro-enteritis has long been known, but it is only in the last 10 years, and especially in the last 5 years, that the rôle of enteropathogenic *Escherichia coli* (EPEC or EEC) has been appreciated. Widely divergent views on their aetiological significance have been expressed—probably mainly owing to the zeal with which the subject has been pursued. More than 20 strains[51] of EEC have been implicated in epidemics of diarrhoea, and presumably the more strains sought for, the more will be found. While many series of studies indicate that EEC may account for some 20-25% of cases of infantile gastro-enteritis,[52-55] one series in Russia implicated EEC in 50% of cases.[56]

In America in particular there are adequate reports[57-59] to indicate the remarkable ease with which newborn infants may be infected with EEC carried by their mothers, although these infants

do not necessarily show clinical diarrhoea, for reasons which are obscure. In one study of 360 parturient mothers, about 13% had EEC (11 strains tested) and in this group 40% of their infants had the selfsame EEC isolated from their stools within 4 days of birth.[58] In another study about 25% of infants, shortly after birth, exhibited the same *E. coli* serotypes as their mothers.[59] In Germany EEC were reported as being rife in mothers and nurses, and in breast milk given by bottle. Some 9% of mothers were carriers of EEC, and infant infection occurred shortly after birth, during birth, or perhaps even earlier.[60]

But if EEC are responsible for diarrhoea, their presence is not the only factor in the occurrence of diarrhoea. The food ingested also seems to be significant and may modify the course of the diarrhoea. *E. coli* and EEC grow differently in milk media containing added sugars. The addition of sucrose rather than glucose, maltose or lactose, favours the growth of EEC.[61] However, human milk produces an intestinal situation which is inhibitory to the growth of all types of EEC. It possesses a factor necessary for the establishment and maintenance of a high formic-acid level in the intestine, and a lower pH value—both factors being inimical to the growth of EEC.[62]

Just being considered as aetiological factors at present are the viruses, in particular the entero-cyto-pathogenic-human-orphan (ECHO) viruses.[63-66] It is conceivable, if not probable, that future investigations will show that these organisms play the principal rôle in the causation of infantile gastro-enteritis—at least in well-cared-for infants from good homes—but it seems unlikely that the type of milk diet will affect the viruses in the same way that it affects the growth of *E. coli* and EEC.

Milk alterations in diarrhoea are being relegated to a menial and secondary rôle, not only by virtue of the appreciation of the part played in diarrhoea by micro-organisms, but also by a better understanding of the profound biochemical alterations which may be induced by the diarrhoea, by vomiting, and by ill-considered treatment.

CLINICAL BIOCHEMISTRY

The states of electrolyte imbalance in gastro-enteritis have been considered elsewhere,[67] but it is necessary to review briefly the effects on the body fluids of milk modifications administered during the course of gastro-enteritis, and the rôle of the kidney in this scheme.

Finkelstein[3d] described infants wasting away from what he termed 'decomposition'. Twenty years later, the first glimmerings of the rôle of water in body metabolism were noted,[68] and it rapidly became clear that 'decomposition' was really 'dessication'. From this period (1920), fluid therapy has burgeoned to bewildering complexity, reflecting the increasing importance of clinical biochemistry in child care.

Finkelstein[3d] did tinker with the electrolytes of milk. His protein milk was low in sodium and potassium, for he hoped by this means to produce more solid-looking stools. However, deficiencies in electrolyte intake are not conducive to recovery from gastro-enteritis.

The addition of lactic acid to milk is theoretically bad. It may be responsible for causing some degree of metabolic acidosis,[69] and in severe diarrhoea there is no need to aggravate the metabolic acidosis already present.

Skimmed milk is used almost universally in infantile gastro-enteritis, the fat being considered harmful and indigestible. But Gomez observed that '. . . the fear of losing other nutrients, especially some minerals, by increasing the intake of foodstuffs in general, and of fat in particular, does not seem to be justified'. He continued '. . . it seems useful to insist that the long-established practice of either reducing or suppressing the intake of fat in steatorrhoea, particularly in malnourished children, seems to be unnecessary and might even be undesirable'.[70] Certainly I have never understood the use of skimmed milk in kwashiorkor, with or without diarrhoea, and cannot imagine that it is superior to whole milk for this purpose.

In recent years we have been hearing a great deal about osmolar loads in the presence of renal insufficiency. Despite a comparatively large extracellular-fluid compartment, the infant has a high rate of fluid turnover, perhaps two or three times that of the adult, and cannot tolerate fluid depletion. The young infant needs comparatively more fluid to excrete the same osmolar load. Older children and adults can concentrate urine highly and can excrete something like 1,400 m0sm. of solute per litre of urine. Premature infants, and newly born mature babies can only excrete some 600-700 m0sm. per litre, though by the second month of life they can manage 1,200 m0sm. per litre.[71,72] However, this is no great safety factor, for the fluid turnover is still rapid and the rate of metabolism high.

Fomon[73] has shown that infants up to 6 months being fed only on breast milk, excrete an average of about 100 m0sm. of solute per litre of urine, while those reared on reconstituted (unsweetened and undiluted) whole cow's milk excrete an average of about 500 m0sm. per litre of urine, the excess of solute being largely made up of phosphates and products of protein catabolism. Among prematures, or term infants in the first month of life, renal function, as judged by adult standards, is rather limited, for the kidney can only concentrate to about half the adult standard, so that such infants, fed on whole cow's milk, do not have much water available as a reserve in the event of environmental heat, fever, vomiting or diarrhoea. Breast-fed infants have 4 or 5 times the water available for solute excretion as compared with babies getting whole cow's milk. In the second month of life, however, kidney concentrating ability is markedly increased, reaching levels of about 1,200 m0sm. per litre, which is almost that of adult proportions (1,400 m0sm. per litre).

However, levels reached in health do not necessarily apply in sickness. In the acute phase of hypertonic dehydration, when there is urgent need for maximum solute excretion in minimum water volume, the infant kidney seems unable to concentrate to more than 400-700 m0sm. per litre, much below the theoretical possibility of 1,200 m0sm. per litre. The cause of this interference with normal expected water conservation in infants with diarrhoea is not understood, but might result from absolute potassium lack or the effects of the toxic products produced by the infecting organisms.[74]

Darrow[75] has made the important observation that solute excretion in infants should be seen in the light of calories metabolized, rather than in terms of patient weight or surface area, and has suggested that 100 calories metabolized should be adopted as a standard of reference.

Infants being treated on intravenous dextrose and electrolytes only (in the commonly used concentrations) produce somewhere around 20-25 m0sm. of solute per 100 calories metabolized, while infants on a conventional cow's milk and solid diet produce more like 35-40 m0sm. per 100 calories,[33b,75] the excess being mostly derived from phosphates and the products of protein catabolism. What is thus of importance, as far as solute load is concerned, is not the number of calories supplied, but the amount of protein per calorie supplied. In this context, protein takes on a new rôle, as a substance which may embarrass renal function at a time when its function may be already impaired consequent on the dehydration following diarrhoea, vomiting, hyperventilation, fever, and environmental heat.

Cooke[51] thus regards the use of skimmed milk in diarrhoea as unwise, for 'skimmed milk presents a high renal-solute load at a time when extra-renal losses of water are high'. The 6th edition (1954) of Nelson's *Pediatrics*[33a] advocates the use of skimmed milk, or skimmed lactic-acid milk in diarrhoea. The 7th edition (1959)[33b] now condemns this practice as being responsible for hypertonic dehydration, which 'occurs . . . particularly when the renal-solute load is high, as when boiled skimmed milk is fed to infants with diarrhoea'. Finberg considers the use of skimmed milk physiologically irrational for 'the load of electrolytes and protein (chief constituents of the solute load) *per calorie* is much greater in skimmed milk than in whole milk'.[34]

Reflecting this new view on osmolar relationships, recent advertisements for at least one type of milk preparation adopt a fresh and novel outlook. No longer is attention drawn to alterations in the carbohydrate, fat and protein moieties. Instead we find one advertiser praising his milk product thus: 'For fluid balance feed Bremil, because renal-solute load and water requirements are kept within normal limits by a physiological protein/electrolyte pattern comparable to that of breast milk. Particularly important during periods of febrile illness, diarrhoea, and in hot weather'.[76]

CONCLUSION

So the wheel of therapy has turned a full circle and more. In the past the presence of diarrhoea raised fears about the excessive content of protein, fat, carbohydrate and electrolytes in milk. The only milk constituent that was not blamed was the water. Today we know better, for even water may be dangerous, and water intoxication can be fatal. All that has been feared so much in the past is now, with grand illogic, freely given intravenously: sugar, protein, electrolytes; even fat is available for infusion into the veins.[77,78] Of these substances it is the water, the electrolytes, and especially the protein that may cause harm in the presence of complex biochemical disturbances.

It is clear, though, that fat is no longer to be regarded as causing 'intolerance'. On this charge fat must be exonerated. Let there be no equivocation about the matter: fat is good for diarrhoea. In general, fat tends to produce solid stools. It is common practice to restrict fat for as long as the stools are loose, and the stools commonly remain loose for as long as the fat is restricted. Fat is a vehicle for the intake of a number of vitamins. Catabolism of fat makes extra water available to the body—about 1·0 ml. of water per gram of fat metabolized, and in this respect it is twice as efficient as carbohydrate and protein. Fat supplies a high content of calories without producing a solute load on the kidneys. As it is, cow's milk is very inferior to breast milk as a source of essential unsaturated fatty acids[79,80] and tocopherol.[81,82] When partially skimmed cow's milk is given to infants from birth, their plasma level of vitamin E remains consistently low.[81] Half-cream milk is especially popular in England for the feeding of infants in the first few weeks. When it is considered that this practice deprives such infants of essential fatty acids and vitamin E, it is seen to be of dubious value. Moreover, it is done at a time when the kidney function is limited (by adult criteria), thus presenting a high solute load (of protein) per calorie ingested; and this form of feeding is especially to be deprecated in the presence of diarrhoea; it is quite unphysiological.[83]

In the treatment of diarrhoea the use of whole cow's milk (better still, breast milk) is indicated. There is no need to dilute it with water on the basis that somehow the milk is 'heavy' and hazardous, and aetiologically linked with the diarrhoea; and unless vomiting is present (with the danger of aspiration) there is certainly no need to stop milk altogether. Cow's milk is a valuable source of electrolyte in hypotonic concentration, viz. sodium about 25 mEq./l., chloride about 30 mEq./l., potassium about 40 mEq./l., and calcium, magnesium and phosphate are also present. Extra water must be administered in order to replenish body deficits and to enable the kidneys to function properly, but it is misleading especially to the parents, to insist on the dilution of the milk, for the milk is blameless. The water may be given separately. Though the result is the same, the concept differs.

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