

Patrick Fitzpatrick and Alf Nicholson discuss the management of dehydration caused by vomiting and diarrhoea in young children



Effects of acute gastroenteritis

ACUTE GASTROENTERITIS is defined as the rapid onset of diarrhoea with or without nausea, vomiting, fever or abdominal pain and, in temperate climates, is caused by a viral agent in over 80% of cases. Gastroenteritis causes millions of deaths in under five-year-olds in developing countries and it is one of the most common reasons for hospitalisation in developed countries.

Acute gastroenteritis is usually mild and tends to settle in most children in 48 hours. Antibiotics, antiemetics and antidiarrhoeal agents have no role in the management of viral gastroenteritis in children. Diarrhoea in infancy and early childhood is defined as an increase in stool frequency associated with a change to loose or watery stools.

Gastroenteritis is very common with many children having more than one episode per year. Vomiting usually lasts one to two days and diarrhoea may last five to seven days.

Causes of gastroenteritis

Table 2 highlights the organisms that commonly cause gastroenteritis in Ireland and the UK. Rotavirus is markedly contagious and can spread rapidly within a household. Breastfeeding is protective in infants and reduces rotavirus infection. Prevention of gastroenteritis within a household is by careful hand washing after changing nappies, especially before preparing food and feeding infants, and by sterilisation of bottles and teats for babies up to one year of age.

Differential diagnosis

It is important to make a diagnosis of gastroenteritis and exclude other causes of diarrhoea. Urinary tract infection should be excluded by urinalysis and urine culture. Abdominal pain may be present in acute gastroenteritis but may also be a presenting feature of common surgical conditions such as acute appendicitis.

Intussusception needs to be excluded

in an infant or young child who appears to have abdominal colic with associated pallor, especially if there is blood per rectum. The clinician should be wary that the latter could be a late sign and indicates intestinal ischaemia.

An ultrasound of the abdomen will both exclude and diagnose intussusception. If the diarrhoea is chronic or present from birth, one needs to consider malabsorption (eg. cystic fibrosis), cow's milk protein intolerance and primary lactose intolerance. If a child is toxic and quite unwell, one needs to consider septicaemia and meningitis and thereby empirically treat with intravenous antibiotics.

Assessment

There are many ways to assess a child for hydration status, but the World Health Organization guidelines are relatively easy to use and are reproducible. The most accurate assessment is to find, if available, the difference between the pre-illness

Table 1

weight and the weight at the time of presentation. Accurate pre-illness weights, however, are rarely available.

The frequency and volume of urine passed in the preceding 24 hours is a fairly reliable guide to hydration status. Clinical signs of dehydration may not correlate with laboratory findings and therefore urea and electrolytes have limited value in the assessment of the degree of dehydration.

The risk of dehydration in children is related to age. Studies from the Indian subcontinent have identified a number of risk factors for the development of dehydration and these include age under 12 months: frequent stools (> 8 per day), vomiting (> 2 episodes per day), undernutrition prior to gastroenteritis, discontinuation of breast feeding and failure to give oral rehydration solutions (ORS) during the illness.

Recommendations on assessment of hydration status:

- Assess the risk of dehydration on the basis of age (highest in young infants) and the frequency of watery stools and vomiting
- Assess severity of dehydration on the basis of recent weight loss (if possible) and clinical examination. Signs of proven value in assessment include: tachycardia; dry oral mucosa; increased thirst; sunken eyes; decreased skin turgor; and altered neurological status. The latter is usually seen in severe dehydration.

Hospital referral

The essential steps for calculation of fluid requirements in a child with acute gastroenteritis are as follows:

- A daily (24 hour) maintenance requirement which is needed by all children (ie. children 10-20kg in weight should have 75ml/kg/day and those under 10kg should have 100ml/kg/day)
- Replace ongoing losses due to vomiting and diarrhoea (each significant stool and vomit should be replaced by 10ml/kg of the recommended fluid)
- Correct dehydration if mild to moderate dehydration (50ml/kg over four hours if a child is 5% dehydrated).

If severe dehydration is suspected or if a child continues to vomit and will not tolerate oral fluids, then the child should be referred to hospital.

Intravenous rehydration should be reserved for those children with severe dehydration.

Nine pillars of good treatment of gastroenteritis

- Use of oral rehydration solutions
- Hypotonic ORS (sodium 60mmol/l , glucose 75-110mmol/l)
- Give ORS quickly over three to four hours
- Rapid reintroduction of normal feeds (including solids) post-ORS
- Use of special formula is not justified
- Use of dilute formula is not justified
- Breastfeeding should continue
- Supplement excess losses due to diarrhoea with added ORS
- No unnecessary medications (antiemetics/antibiotics/antidiarrhoeals) should be prescribed

Oral rehydration

It is important to stress to parents that oral fluids should be given little and often, as children with gastroenteritis do not tolerate large volumes of fluid. In a young child, this is best achieved by administering fluids with a cup or via a spoon rather than a bottle. Administration of large boluses may result in further vomiting. There several oral rehydration solutions (ORS) available.

In one of the great paediatric advances of the 20th century, the discovery in the mid 1960s that there was coupling of the transport of glucose and sodium in the gut, allowed the development of ORS, which has made an enormous contribution to the management of dehydration and has saved literally millions of lives worldwide. ORS are formulated to allow the most efficient use of the sodium-glucose co-transporter in the gut epithelium.

McKenzie et al found that almost 90% of children who would previously have received intravenous fluids, could be successfully rehydrated using ORS in a short-stay unit in a hospital setting. Thus the trend is now to favour ORS over intravenous fluids for rehydration.

There is good evidence that reduced osmolarity glucose-based ORS (eg. Dioralyte/Rapolyte) are the most suitable ORS in the Irish setting in patients with diarrhoea (usually viral) and mild to moderate dehydration

Contrary to popular parental belief and advice currently given by many medical practitioners, the following fluids are unsuitable for administration:

- Soft drinks (commercial or home-made including flat 7-up and cola have a fructose/glucose content = 700mmol/l)
- Sweetened fruit drinks (apple juice has a glucose/fructose/sucrose content = 690mmol/l)

Table 2

Common causes of acute gastroenteritis

Viral

- Rotavirus
- Adenovirus
- Small round spherical virus
- Astrovirus

Bacterial

- *Salmonella*
- *Campylobacter*
- *Shigella*
- *E. Coli*
- *Yersinia*

Parasites

- Giardia
- Cryptosporidia

- Sweetened tea
- Medicinal teas
- Lucozade.

All of the above present the gut with a high osmotic load with insufficient electrolytes and may result in osmotic diarrhoea.

Composition of ORS

The European Society for Paediatric Gastroenterology and Nutrition (ESPGAN) have recently issued guidelines recommending a sodium content of 60mmol/l and the use of a hypo-osmolar ORS for European children.

In underdeveloped countries, cereal/rice-based ORS have been developed and these are especially effective in the management of cholera. Most ORS products contain 20mmol/l of potassium and this appears sufficient to prevent hypokalaemia.

Thus an ORS containing sodium 60mmol/l , glucose 90mmol/l, potassium 20mmol/l and citrate 10mmol/l with a low osmolality of 240mmol/l is both safe and

Table 3

Practice points for dehydration and acute gastroenteritis

- Infants under six months old with gastroenteritis are more difficult to assess and one should, in this age group, have a lower threshold for hospitalisation
- Any child vomiting more than four times and/or passing liquid stools more than eight times per 24 hours should be seen by their doctor to assess hydration status
- Breastfeeding should continue through rehydration and formula feeding should be restarted after completion of rehydration. Formulas should not be diluted
- Advise parents not to give soft drinks ('flat 7-up'), sweetened fruit drinks or tea in place of oral rehydration therapy
- The key to successful oral rehydration is to ignore the stool consistency and concentrate on oral intake and hydration status
- Oral rehydration therapy works speedily, has a low failure rate and is preferable to intravenous rehydration in mild to moderate dehydration
- For oral rehydration therapy, small spoonfuls every 10-15 minutes are better tolerated than larger volumes
- Reintroduce solid feeds early and avoid prolonged starvation. Children should be back on full diet 24 hours after beginning treatment
- Antidiarrhoeals such as loperamide and diphenoxylate with atropine (Lomotil) are not recommended in children with gastroenteritis
- Antiemetics, with the exception of ondansetron, carry a risk of dystonic reactions and likewise should be avoided
- Most bacterial gastroenteritis does not require or benefit from antibiotic treatment. Antibiotics may be recommended in salmonella gastroenteritis in the very young, if immunocompromised or if systemically ill

effective for the prevention and treatment of dehydration in European children with acute gastroenteritis.

Rehydration with ORS

Rehydration should take place rapidly over a three- to four-hour period. ORS is given by bottle, cup or spoon and it is preferable to give little and often to correct dehydration over four hours.

If the child is vomiting, use small amounts of ORS (initially 5ml every three to five minutes) and as the child's condition improves larger volumes may be given. The ORS can be frozen and offered in the form of an ice lolly or use flavoured ORS if the child is over one year of age.

Most dehydrated children are thirsty and will take ORS readily but seriously ill children may require ORS via NG tube. If the child has further vomiting or diarrhoea, then these added losses should be estimated and more ORS given.

If there is hypernatraemia (ie. serum sodium >150mmol/l), then ORS should be given as fluid replacement over 12 hours and this has been found to reduce the risk of seizures. In hypernatraemic dehydration, ORS is safer than intravenous rehydration.

Use of antiemetics/antidiarrhoeals

The risks of loperamide are cited in 10 reports of adverse effects and include accidental poisoning, necrotizing enterocolitis, toxicity, neurological symptoms, delirium, respiratory depression and coma. The risks of loperamide in gastroenteritis outweigh possible benefits. Likewise Lomotil (diphenoxylate and atropine) and anticholinergic drugs are not recommended for the treatment of diarrhoea.

Due to their potential to cause dystonic reactions, antiemetics (eg. Stemetil, Motilium) are not recommended in acute gastroenteritis

Ondansetron is a selective 5-HT₃ receptor antagonist, which affects serotonin receptors of the vagal nerve and also acts centrally on the chemoreceptor trigger zone. It is an effective antiemetic and has a proven clinically significant effect on the cessation of vomiting but does not reduce overall the number of admissions with gastroenteritis.

In its use to improve the success of ORT, ondansetron did show a reduction in the median number of further emesis episodes. Ondansetron has a good side-effect profile compared to other antiemetics. Overall several randomised controlled

trials have shown that, in children with persistent vomiting during ORS, the administration of oral ondansetron can increase the likelihood of successful oral rehydration. The only other issue is that diarrhoea is more pronounced in those given ondansetron than in the placebo groups.

Reintroduction of solids

There is now good evidence that food restriction or starvation results in weight loss, diarrhoea of longer duration and a slower recovery of intestinal function. However, fatty foods or those high in simple sugars should be avoided as they may result in osmotic diarrhoea.

Early feeding may decrease the changes in intestinal permeability caused by infection and therefore hasten recovery. Early feeding may also lead to enterocyte healing and maintenance of disaccharidase activity.

Therefore, solids should be reintroduced as soon as possible and food should be reintroduced irrespective of the presence of diarrhoea. Then after ORS for four hours, normal feeds should be reintroduced immediately thereafter.

Post gastroenteritis diarrhoea

Many children will have ongoing diarrhoea for up to two weeks post-gas-

troenteritis and very few actually have post-gastroenteritis lactose intolerance. Routine use of lactose-free formula or dilution of milk post-gastroenteritis is not recommended.

If diarrhoea is persistent, a stool pH and stool for reducing substances should be measured and if the stool is acid and contains >0.5% reducing substances, a lactose-free milk should be considered.

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