



Investigating the child with acute diarrhoea

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In this series, we present authoritative advice on the investigation of a common clinical problem, specially commissioned for family doctors by the Board of Continuing Medical Education of the Royal Australasian College of Physicians.

Acute diarrhoea is a common symptom in childhood and is caused by an increase in the fluid content of stools, resulting in an increase in their frequency and a change in stool consistency. Acute infectious gastroenteritis, the main cause of acute diarrhoea, is usually due to a viral or bacterial infection and can be accompanied by vomiting, fever, anorexia or nausea. In Australia, around 70% of cases of acute gastroenteritis are due to a viral infection (usually rotavirus). Bacterial infections are responsible for about 15% of cases and the most commonly implicated bacterial pathogen is *Campylobacter jejuni*. Causes of acute diarrhoea other than viral or bacterial infections are rare.

For most children, acute infectious diarrhoea is a self-limiting illness that only requires treatment with oral fluid therapy. If acute diarrhoea is inappropriately managed, however, it can be complicated by dehydration, acid-base and electrolyte disturbances, shock, fluid overload and even death.

Rare complications associated with bacterial diarrhoea include haemorrhagic colitis, systemic sepsis and the haemolytic uraemic syndrome.

The WHO estimates that over four million children aged under 5 years die from diarrhoea and its complications each year in South East Asia alone.¹ In developed communities, death from gastroenteritis is rare; however, recent reports of iatrogenic intravenous fluid overload, leading to hyponatraemia, raised intracranial pressure and death remind us of the potential risks associated with the management of acute diarrhoea.²

Community costs

Although overall mortality rates are low in the developed world, the costs associated with managing acute diarrhoea are high. In Australia rotavirus gastroenteritis in children under 5 years leads to approximately 10,000 hospital admissions, 22,000 visits to emergency departments and 115,000 visits

IN SUMMARY

- Acute diarrhoea is common in children and usually infective. Rotavirus infection is the most common cause.
- Investigations are not usually required for acute diarrhoea because the condition is mostly self-limiting.
- The majority of children with acute diarrhoea can be treated at home with oral fluids.
- Dehydration associated with acute diarrhoea can be prevented with appropriate treatment.
- Severely dehydrated children require hospital admission for enteral or intravenous fluid rehydration.
- Antibiotics, antiemetic and antidiarrhoeal agents are rarely required and may have adverse effects in children.
- Vaccination with the new rotavirus vaccine should be recommended for all babies commencing at 2 months of age.

Table 1. Causes of infectious gastroenteritis in children*

Viral

- Rotaviruses
- Enteric adenoviruses
- Small round structured viruses (including Noroviruses)
- Caliciviruses
- Astroviruses
- Enteroviruses

Bacterial

- Campylobacter jejuni*
- Non-typhoid *Salmonella* spp
- Enteropathic *Escherichia coli*
- Shiga-toxin producing *E. coli*
- Shigella* spp.
- Yersinia enterocolitica*
- Staphylococcus aureus*
- Salmonella typhi* and *Salmonella paratyphi*
- Vibrio cholerae*

Protozoan

- Cryptosporidium*
- Giardia lamblia*
- Entamoeba histolytica*

Helminth

- Strongyloides stercoralis*

* Listed in approximate order of frequency.



PHOTOLIBRARY

identification of children with diarrhoea who warrant specialist referral.

Diagnosis

Obtaining a history and performing an examination are important components in the diagnostic process of a child with acute diarrhoea and help differentiate common infectious from uncommon noninfectious causes. Also, history taking and examination help determine whether the aetiology of the child's diarrhoea is viral or bacterial. Causes of infectious and noninfectious acute diarrhoea in Australian children are listed in Tables 1 and 2.

Taking a history

When assessing the child with diarrhoea it is useful to think first of an infectious cause and ask whether the child has had any contact with people who have had diarrhoea and/or vomiting within the family or at day care or school. Occasionally, acute gastroenteritis results from ingestion of contaminated food or milk. A recent diet history is particularly important if the affected child is part of an institutional or family 'outbreak' in which all affected individuals developed diarrhoea around the same time. For example, ingestion of ice cream or cream contaminated with a *Staphylococcus aureus* toxin usually results in diarrhoea and/or vomiting within six to 12 hours of ingestion.

Figure 1. Acute diarrhoea is mostly a self-limiting illness that can be managed at home using oral rehydration solutions.

to GPs annually with associated health system costs of around \$30 million.³ In another report, the cost of treating one child in the community was valued at about \$4441 with additional costs to families, including time off work, adding approximately \$228 to every diarrhoeal episode experienced by each child.⁴ In Australia, rates of diarrhoea are eight times higher in indigenous children than in nonindigenous children.^{5,6}

The significance of primary care in the management of acute gastroenteritis was highlighted by two NSW studies which found 70% of carers with children admitted to hospital with gastroenteritis had sought initial management advice from their GP.^{7,8} This emphasises the fact that the GP is the primary source of assessment and treatment for most children with acute diarrhoea and for the

Table 2. Noninfectious causes of diarrhoea

- Food allergies – e.g. cow’s milk protein intolerance, colitis
- Surgical causes – e.g. acute appendicitis, partial small bowel obstruction
- Endocrine causes – e.g. diabetic ketoacidosis, hyperthyroidism, neuroendocrine tumours
- Toxic causes – e.g. laxatives, ferrous sulfate, antibiotics
- Chronic disease presentations – e.g. coeliac disease, chronic inflammatory bowel disease

Table 3. Acute diarrhoea in children: when to treat at home or refer

When to treat at home

- The child is either not dehydrated or only mildly dehydrated
- The child’s vomiting is not interfering with his or her fluid intake
- The family is able to cope at home

When to consider referral

- There is doubt about the diagnosis
- The child looks very unwell
- The child is moderately or severely dehydrated
- The child is younger than 6 months of age
- The family is unable to cope
- The child’s condition has rapidly deteriorated
- The child has profuse diarrhoea
- Persistent vomiting is interfering with the child’s fluid intake
- The child has pre-existing disease – e.g. diabetes, previous bowel resection or a metabolic condition

Ingestion of pathogenic bacteria such as *Salmonella* spp. or *Escherichia coli* in uncooked meat such as hamburger mince or chicken may cause bloody diarrhoea 12 to 24 hours later. Recent overseas travel to regions such as South East Asia should alert the GP to the possibility of an unusual pathogen – e.g. *Salmonella typhi*, *Salmonella paratyphi*, *Vibrio cholerae* or *Entamoeba histolytica*.

Infections outside the gastrointestinal tract can also cause acute diarrhoea in children. These infections can include urinary tract infection, otitis media, septicaemia, pneumonia (particularly in young children) and meningitis.

Distinguishing viral from bacterial diarrhoea

The nature of the diarrhoea, its frequency, and its accompanying features may provide a clue to its cause and help guide management. For example, rotavirus damages the small bowel and causes profuse watery diarrhoea without blood. It is also associated with mild abdominal pain, vomiting (almost always), a low-grade fever (less than 38.5°C) and a concomitant upper respiratory tract infection. Rotavirus infection occurs in children of any age, but particularly in those aged less than 2 years. Rotavirus epidemics occur in the winter months and spread from person-to-person by faecal–oral or respiratory routes.

In contrast, *C. jejuni* affects both the small and large bowel and infection is associated with blood and mucus in watery stools, fever, severe abdominal pain and tenesmus. Vomiting is rare in *C. jejuni* infection. Bacterial infections may be acquired from contaminated food, person-to-person spread, farm animals or contaminated environments such as swimming water.

Identifying noninfectious causes of diarrhoea

When a cause of diarrhoea other than gastroenteritis is suspected, the history and

examination should be directed at excluding a surgical cause such as appendicitis, an endocrine disorder, or diarrhoea caused by ingestion of a toxin. Occasionally a bout of acute diarrhoea may be the first presentation of a chronic disorder such as coeliac disease or inflammatory bowel disease. Usually, however, these conditions are associated with chronic diarrhoea for a period of longer than two weeks in the presence of other typical signs and symptoms (see Table 2).

Clinical examination

Clinical assessment of the child with diarrhoea should include the following:

- measurement of temperature
- examination for signs of an acute abdomen
- examination for signs of systemic or focal infection
- assessment of the child’s degree of dehydration.

Assessing dehydration

Assessing the degree of dehydration may be difficult in the child with acute gastroenteritis but it is important because it determines the best course of management, including whether a child can be managed at home or whether referral to a paediatrician or hospital is necessary (Table 3). The degree of weight loss is the best indicator of dehydration. Information on the child’s previous weight may be available from patient-held records such as a child health record. It is difficult to assess accurately the exact degree of dehydration from clinical examination.^{9,10} Features associated with mild, moderate and severe dehydration and associated bodyweight losses are outlined in Table 4.⁹ Indeed, the extent of dehydration is often overestimated clinically, even by trained paediatricians.¹⁰ The following signs are seen more often in children with significant dehydration (losses of greater than 6% of their body weight):

- decreased skin turgor
- sunken eyes

continued

| Clinical feature | No dehydration | Mild to moderate dehydration | Severe dehydration |
|---------------------------------|--|---|--|
| Loss of body weight | Nil | 5% or less (mild) 6 – 9% (moderate) | Greater than 10% |
| Clinical signs | Absent | Two or more of the following signs: – thirsty – irritability – restlessness – absent tears – sunken eyes (ask parents about this) | Two or more of the following: – tachypnoea – drinking very little or nothing – sunken eyes – sunken fontanelle – abnormally sleepy or lethargic – circulatory collapse (tachycardia, weak pulse, cool peripheries, prolonged capillary refill) |
| Pinch test (skin turgor) | Normal: skin fold retracts immediately | Slow: skin fold visible for less than 2 seconds | Very slow: skin fold visible for 2 seconds or more |

- dry oral mucosa
- altered neurological status (irritability or drowsiness).

Investigations
Identifying the pathogen in acute gastroenteritis

Identifying the pathogen responsible for infectious diarrhoea is not always possible, necessary or cost-effective in the community setting.^{11,12} A definitive diagnosis may be necessary for public health reasons,

such as when monitoring an outbreak in a hospital, residential institution, child-care setting or school. Testing health workers, child-care workers and food handlers with diarrhoea is warranted because they may transmit infection to large numbers of people.

Knowledge of the pathogen implicated in these circumstances helps public health authorities track the spread and extent of outbreaks and identify the outbreak source. A list of nationally notifiable

gastrointestinal infections and State and Territory specific notifiable infections is outlined in Table 5,^{13,14} and website resources for making disease notifications for each State and Territory are outlined in Table 6.

Stool testing

Stool testing of all children with acute diarrhoea is not necessary. The yield from stool cultures is very low and the cost high. Also, the availability of various diagnostic methods and the prevalence of individual pathogens vary considerably in different settings. The yield from stool cultures can be increased significantly if they are performed only in children with features of invasive bacterial disease such as those with fever, blood in the stool or tenesmus or when stool microscopy reveals white and red blood cells.¹³

Confirming viral infections

Viral infection can be confirmed using a commercial assay or electron microscopy in the hospital or research setting, but this level of confirmation is rarely sought in the community because most viral gastroenteritis is mild and self-limiting. Mandatory reporting is required for a range of stool isolates (see Table 5).

| | |
|---|--|
| <ul style="list-style-type: none"> • Amoebiasis (NT, Tas, WA) • Botulism – confirmed cases with clinical evidence* • Campylobacteriosis* • Cholera* • Ciguatera poisoning (Qld) • Cryptosporidiosis* • Food borne or water borne diseases in two or more related cases (NT, Qld, Tas, Vic) • Gastroenteritis among people of any age in an institution or in food handlers (NSW, NT, Tas) | <ul style="list-style-type: none"> • Giardiasis (ACT, Vic, Tas, WA) • Haemolytic uraemic syndrome – confirmed cases based on clinical evidence* • Rotavirus infection (NT) • Typhus (NT) • Salmonellosis* • Shiga toxin-producing/vero toxin-producing <i>Escherichia coli</i> infection* • Shigellosis* • Typhoid fever* • Vibrio food poisoning (NT, TAS) • Vibrio parahaemolyticus infection (WA) |
|---|--|

*Nationally notifiable diseases agreed by all jurisdictions. Cases must be laboratory confirmed.

Table 6. Websites for information on notifiable diseases

| |
|---|
| Australian Capital Territory www.health.act.gov.au |
| New South Wales www.health.nsw.gov.au/infect/notify.html |
| Northern Territory www.nt.gov.au/health/cdc/cdc.shtml |
| Queensland www.health.qld.gov.au/phs/documents/cdu/notif_conditions_rpt.pdf |
| South Australia www.dh.sa.gov.au/pehs/communicable-diseases-index.htm |
| Tasmania www.dhhs.tas.gov.au/services/view.php?id=722 |
| Victoria www.health.vic.gov.au/ideas/notifying/index.htm |
| Western Australia www.notifications.health.wa.gov.au/notifications/communicable/index.cfm |

Diagnostic tests for the clinically dehydrated child

In the child who is clinically dehydrated, measurement of serum urea, bicarbonate, electrolytes and venous pH should be considered. It is essential to measure serum electrolytes in any child who requires intravenous fluids. If a child with diarrhoea appears pale, has evident bruising or has oliguria/anuria, then a diagnosis of haemolytic uraemic syndrome should be considered.¹⁵ In such cases a full blood count and blood film (for anaemia, thrombocytopenia and fragmentation of red blood cells) should be performed. An estimate of urea and creatinine concentration should also be obtained. Other investigations may be necessary if the cause of diarrhoea is not clear or when diarrhoea persists for more than 10 days (Table 7).

Table 7. Acute diarrhoea in children: which investigations?

| Investigation | When to perform |
|---|--|
| Full blood count and film | High fever Suspected sepsis Suspected anaemia Anuria Bruising |
| Urea and electrolytes | Dehydration requiring IV fluids Anuria Acute abdomen |
| Liver function tests | Jaundice Hepatomegaly Faltering growth |
| Blood glucose level | Altered level of consciousness Poor oral intake Moderate to severe dehydration Known or suspected diabetes |
| Blood culture | Fever >38°C Suspected sepsis or shock |
| Arterial blood gas | Severe dehydration Sepsis Known/suspected diabetes |
| Erythrocyte sedimentation rate and/or C-reactive protein | Suspected sepsis Suspected or known inflammatory bowel disease Acute abdomen |
| Anti-tissue transglutaminase antibodies | Suspected coeliac disease |
| Stool examination (microscopy, culture and viral studies and stool reducing substances) | Severe illness Blood in stools Suspected epidemic of food borne illness Recent overseas travel Diarrhoea for more than 10 days Public health risk – e.g. children in hospital |
| Urinalysis (with or without microscopy, culture and sensitivity) | High fever Dysuria and frequency Pre-existing renal disease Faltering growth Hypertension or hypotension Past history of urinary tract infection |

When to be cautious

Young infants are at particular risk of dehydration. Total body water and extracellular fluid volume are both greater in infants. In dehydration due to diarrhoea water is initially lost from the extracellular

space making losses in infants proportionally greater. Referral for further evaluation and a period of observation should be considered for all infants less than 6 months of age with acute diarrhoea, and is essential if vomiting is interfering with

Investigating the child with acute diarrhoea

continued

feeding and/or diarrhoea is profuse. Table 3 lists other examples of children who may need referral. In young children diarrhoea and vomiting are nonspecific symptoms and may be a manifestation of conditions other than gastroenteritis.

Treatment

Rehydration

The key to therapy is the provision of adequate amounts of appropriate fluids given orally to treat or prevent dehydration. Most children with uncomplicated diarrhoea and mild dehydration (loss of less than 6% of body weight) can be managed in the community. For those with significant diarrhoea and/or vomiting due to gastroenteritis the first choice for fluid replacement is a glucose-electrolyte or rice-electrolyte oral rehydration solution.^{9,16}

Oral rehydration solutions are scientifically formulated to maximise sodium and water absorption and several different solutions (in a range of flavours) are available commercially (Table 8). Oral rehydration solutions are underprescribed by GPs for children with acute diarrhoea.⁷ Carbonated or sports drinks, cordials and fruit juices usually have a high glucose content and their high osmolality exacerbates diarrhoea and increases the risk of dehydration.

Refeeding

In children with acute gastroenteritis early refeeding with a normal diet should be encouraged after 4 of 6 hours rehydration.^{9,16} In formula fed babies there is no need to dilute formula when it is reintroduced. Breastfeeding should be continued throughout an episode of acute diarrhoea.^{9,16}

Hospital admission

Hospital admission for fluid therapy is required when a child has moderate or severe dehydration where approximately 7 to 10% of their body weight has been lost. In hospital fluid therapy may be administered enterally, either orally or by nasogastric tube, or may be given intravenously.^{9,16} Administering fluids via a nasogastric tube is a safe and effective way to treat children with dehydration, even when they are vomiting. Intravenous fluids are always needed if a child is in shock (greater than 10% weight loss). Protocols for the use of nasogastric or intravenous fluids vary between hospitals.

The role of medications

Antibiotic, antiemetic and antidiarrhoeal agents are rarely indicated but often used unnecessarily in acute diarrhoea.^{9,16,17} These medications can cause significant harm in children. Antiemetic agents have no proven benefit in treating acute gastroenteritis and may cause dystonic reactions in children. Antimotility agents such as loperamide may reduce the duration of diarrhoea but are

continued

Table 8. Composition of oral rehydration solutions available in Australia

| Constituents | Recommended composition* | Gastrolyte [†] | Hydralyte [†] | Pedialyte [†] | Repalyte New Formula [†] | Gastrolyte-R [‡] |
|---------------------|--------------------------|-------------------------|------------------------|------------------------|-----------------------------------|---------------------------|
| Glucose (mmol/L) | 90 | 90 | 80 | 126 | 90 | 90 |
| Sodium (mmol/L) | 60 | 60 | 45 | 45 | 60 | 60 |
| Chloride (mmol/L) | 60 | 60 | 45 | 35 | 60 | 50 |
| Potassium (mmol/L) | 20 | 20 | 20 | 20 | 20 | 20 |
| Base (mmol/L) | Citrate 10 | Citrate 10 | Citrate 30 | Citrate 10 | Citrate 10 | Citrate 10 |
| Osmolarity (mOsm/L) | 240 | 240 | 220 | 210 | 240 | 226 |

* European Society of Paediatric Gastroenterology, Hepatology and Nutrition. [†] Glucose electrolyte solution. [‡] Rice-based electrolyte solution.

not recommended in children because the risk of side effects, including lethargy, ileus, respiratory depression, coma and death, outweigh the benefits.¹⁷ Antibiotics are not recommended empirically and their use may contribute to the emergence of resistant bacteria.

Prevention

Educating parents and carers in how to prevent recurrent episodes of infectious diarrhoea in their children is important. Parents can be advised and educated about the following preventative issues:

- the role of breastfeeding in preventing intestinal infections
- the need for hand washing after using the toilet, changing nappies or handling animals
- the principles of food preparation and storage to minimise cross

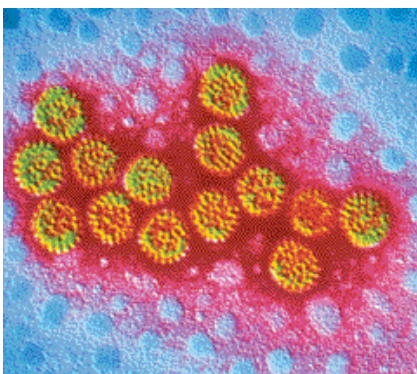


Figure 2. Rotavirus (electron microscopy). Viral infections are responsible for around 70% of acute gastroenteritis in children.

contamination

- the need to keep young children away from others with diarrhoea and vomiting
- the need to keep the child away from daycare or school until symptoms of gastroenteritis abate
- the need to avoid giving young children undercooked minced meat or salami.

Vaccination

Two safe and highly effective rotavirus vaccines have recently been licensed for use in Australia (Rotarix, RotaTeq). The National Rotavirus Vaccination Program, which began in July 2007, provides free rotavirus vaccine for all children born on or after 1 May 2007. Vaccination should be recommended for all infants and is expected to have a huge impact on rates of rotavirus illness, a major cause of acute diarrhoeal disease.¹⁸

Follow up

Children with persistent diarrhoea may have acquired a second infection and it is therefore important to follow up children with acute diarrhoea to ensure their symptoms have resolved. Alternatively complications of acute gastroenteritis such as temporary carbohydrate (lactose) intolerance can follow a bout of diarrhoea. This can be diagnosed by the presence of stool reducing substances (a test result of <0.5% is not significant). Infrequently, an episode of acute diarrhoea in a child may unmask a chronic disease, such as coeliac

disease or inflammatory bowel disease, or a food allergy – e.g. cow's milk protein intolerance.

Conclusion

Children with acute diarrhoea rarely present a diagnostic challenge to the GP. The history usually reveals the most likely cause and investigations are not usually necessary. In the young child with an atypical presentation, a careful history, examination and appropriate investigations will exclude less common causes of diarrhoea. Most children can be managed in the community with oral rehydration therapy and medications are seldom required. The GP must, however, be alert to the potential severe complications of infectious diarrhoea and know when to refer affected children to a specialist. GPs also have the opportunity to advocate for use of new and highly effective rotavirus vaccines.

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A list of references is available on request to the editorial office.

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