CASE 3

Short case number: 3_16_3
Category: Children and Young People
Discipline: Paediatrics_Medicine
Setting: Emergency department
Topic: Acute diarrhoea in children.

Case

Previously well, 20 month old Joshua Ebbeck, presents with a 2-day history of temperature to 38^0 C and vomiting; the vomiting has settled but in the last 12 hours he has started passing frequent, loose bowel motions. On immediate assessment he is alert and well perfused. BP: 90/60 mmHg; HR: 110 bpm; RR 25 bpm; weight 14 kg

Questions

1. Define the terms diarrhoea, acute diarrhoea and chronic diarrhoea.
2. What are the key features of your history and examination of Joshua?
3. What are the main differential diagnoses that need to be considered in the assessment of the child with acute diarrhoea and vomiting?
4. In a table, summarise the key features of osmotic, secretory and inflammatory diarrhoea.
5. Joshua's working diagnosis is acute infective gastroenteritis. Summarise the main causative micro-organisms and outline the pathogenesis of each and the correlation with the clinical features seen.
6. Joshua's diarrhoea continues and he is assessed to be 5% dehydrated. Outline the key clinical features of mild, moderate and severe dehydration.
7. Outline a management plan for Joshua at his current level of dehydration.
8. Joshua remains unwell and becomes further dehydrated. He is assessed to be 8% dehydrated. Calculate Joshua's fluid replacement regimen for the next 24 hours.
9. Joshua recovers from this episode and is discharged home. However, he represents on 2 further occasions over the next 2 months with continuing episodes of diarrhoea, there is no vomiting or fever. His mother comments that his stool has not really returned to normal since the initial episode. Outline the key features of your assessment of Joshua.
10. Outline the key features of the following conditions: chronic non-specific diarrhoea, post-infective diarrhoea, sucrose-isomaltase deficiency and inflammatory bowel disease.

Suggested reading:

Rosenbaum, J. & Alex, G. (2012). Infective diarrhoea and inflammatory bowel disease. In South, M & Isaacs, D. (Eds) Practical Paediatrics (pp 715 – 723) Edinburgh, Churchill Livingston.

ANSWERS

All answers in this section are extracts (+/- minor modification) from:

Roberton, DM and South, M (ed). *(2007) Practical Paediatrics*. (6th ed.). Edinburgh: Churchill Livingstone/Elsevier.

except Q. 9, which is adapted from: Royal Children's Hospital. (2009). *Paediatric Handbook* (8th ed.). Oxford ; Hoboken, NJ: Wiley-Blackwell.

and Q. 5 which is adapted from:
Australian Doctor. (2007) *How to Treat: Paediatric gastroenteritis*. 9/11/2007. http://search.ebscohost.com.ipacez.nd.edu.au/login.aspx?direct=true&db=anh&AN=27598311&site=ehost-live&scope=site

Diarrhoea = • Volume ≥ 10ml/kg/Day
• Consistency (loose/watery)
• Frequency ≥ 3x /24hrs

1. Define the terms diarrhoea, acute diarrhoea and chronic diarrhoea.

Diarrhoea is defined as a measured stool volume greater than 10ml/kg/day. Both the consistency of the stool (loose or watery) and frequency (usually at least three stool sin 24-hour period) are important defining features of diarrhoea. Acute diarrhoea lasts less than 10 days and has a major impact on fluid and electrolyte status, while chronic diarrhoea suggests that the symptom is present for more than 2-3 weeks and can have a significant effect on the nutritional state of a child. (Roberton p. 722)

≤10 Days = Acute
• Worried about electrolyte disturbances

2-3 Weeks = Chronic
Worried about nutritional status.

2. What are the key features of your history and examination of Joshua?

"A history of contact with gastroenteritis can often be established in young children with diarrhoea and vomiting. However, diarrhoea and vomiting are non-specific symptoms in children and may also be associated with a range of infections outside the gastrointestinal tract (e.g., otitis media, urinary tract infection), structural gut abnormalities (malrotation), metabolic diseases (diabetes mellitus), and surgical problems (acute appendicitis).

Viral

Children with viral gastroenteritis (usually due to rotavirus) generally present in autumn or winter with watery diarrhoea without blood, with or without vomiting, low-grade fever and anorexia. Most of these children are under the age of 5 years.

Bacterial

Children with bacterial gastroenteritis are more likely to have a high fever and blood and mucus in the stool.

A travel history should be sought in children with bloody diarrhoea. Haemolytic–uraemic syndrome (characterised by acute renal impairment, thrombocytopenia and microangiopathic haemolytic anaemia) should be considered in any child with bloody diarrhoea, pallor and poor urine output.

Organisms frequently implicated in food- or water-borne infections include species of Salmonella, Campylobacter, Listeria and Clostridia; Norwalk-like viruses (noroviruses); Shiga-toxin-producing Escherichia coli; and cryptosporidium. These infections are most commonly

acquired from imported and takeaway foods, including seafood, red meat or poultry, and unpasteurised milk and contaminated water.

It is not feasible or necessary to take a stool specimen in all children with diarrhoea in the community. However, stool cultures may help guide treatment in very young, immunocompromised children or children with high fever who look particularly unwell; in children with gross bloody diarrhoea or a history of recent foreign travel; and in children who are part of an outbreak of diarrhoea in a child-care, school, community or hospital setting."

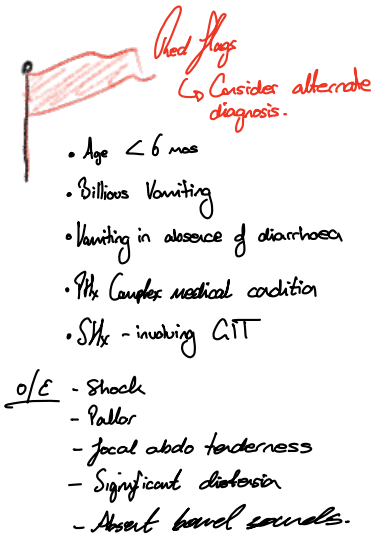
(Source: Elliott, E. J., & Dalby-Payne, J. R. (2004). 2. Acute Infectious Diarrhoea and Dehydration in Children. *The Medical Journal of Australia*, *181*(10), 565-570.) https://www.mja.com.au/journal/2004/181/10/2-acute-infectious-diarrhoea-and-dehydration-children

EXAMINATION:

Exclude surgical (acute) abdomen and other emergencies such as meningitis/sepsis.

Main focus is then on assessment of hydration. See grades of dehydration below (6).

3. What are the main differential diagnoses that need to be considered in the assessment of the child with acute diarrhoea and vomiting?



Differential diagnosis of acute diarrhoea and vomiting in infants and children (source: table 20.2.2, Roberton p.723)
Enteric infection **Rotavirus** **Other viruses** **Bacterial** **Salmonella** **Shigella spp.** **Escherichia coli** **Campylobacter jejuni** **Protozoa** **Cryptosporidium** **Giardia lamblia** **Entamoeba histolytica** **Food poisoning** **Staphylococcal toxin**
Systemic infection **Urinary tract infection** **Pneumonia** **Septicaemia**
Surgical condition **Appendicitis**

	Intussusception **Partial bowel obstruction** **Hirschsprung disease**
Other	
	Diabetes mellitus **Antibiotic diarrhoea** **Haemolytic-uraemic syndrome**

4. In a table, summarise the key features of osmotic, secretory and inflammatory diarrhoea.

B/c intestines secreting heaps of fluid into the lumen (Certain bacterial toxins can cause this).

Classification of diarrhoea (reproduced from Roberton, table 20.2.1, p. 723)			
	Osmotic	**Secretory**	**Inflammatory**
Clinical features	Ceases when enteral feeding is ceased	Continues when enteral feeding is ceased	Presence of blood and mucus in the faeces
Stool volume	<200ml/day	>200ml/day	Variable, usually <200ml/day
Faecal sodium	<60mosmol/l	90 osmol/l	Variable

5. Joshua's working diagnosis is acute infective gastroenteritis. Summarise the main causative micro-organisms and outline the pathogenesis of each and the correlation with the clinical features seen.

Rotavirus is the most common cause of gastroenteritis worldwide. It is noteworthy that it was first identified in 1973 by an Australian researcher, Professor Ruth Bishop, working at the Sydney Children's Hospital. Other viral pathogens include enteropathogenic adenoviruses (serotypes 40 and 41) and, occasionally, astroviruses. More recently, attention has been focused on norovirus, which was previously known as 'Norwalk agent', and on 'small round structured viruses' (SRSVs) as significant causes of gastroenteritis outbreaks, particularly in older children and the adult population.
About 15-20% of cases are a result of bacterial infections with pathogens such as campylobacter species, salmonella species, shigella, enteropathogenic Escherichia coli and Yersinia enterocolitica. Occasionally, infections due to shiga-toxin-producing E coli and vibrio species occur.

E coli that causes gastroenteritis can be further sub-classified into strains according to the mechanism by which they cause diarrhoea. Enteropathogenic E coli often occurs in infants and produces diarrhoea via the direct adherence of the bacteria to intestinal epithelial cells. Shiga-toxin- (or Vero toxin-) producing E coli produce the cytotoxins causing bloody diarrhoea and haemolytic uraemic syndrome.

Food poisoning arises from the ingestion of pre-formed bacterial toxins in food that is inadequately cooked or prepared. The effects are a result of toxins rather than direct infection of the GI tract by pathogenic organisms. Classically the organisms and the toxins implicated are those from Staphylococcus aureus and Bacillus cereus. Episodes often occur in clusters, with the pre-formed toxin resulting in a rapid onset of symptoms, typically less than 24 hours

after ingestion. The illness is usually short-lived and comprises vomiting and diarrhoea without fever of less than 48 hours' duration. Foods typically contaminated with staphylococcal toxins are those that contain contaminated dairy products, such as cream. B cereus food poisoning is associated with rice dishes.

The remaining small percentages of cases of infective gastroenteritis in children are caused by protozoal parasite infections. The usual agents are Giardia intestinalis or cryptosporidium species.

Common childhood helminth infestations such as Ascaris lumbricoides and Enterobius vermicularis do not usually cause diarrhoea. Generally helminth parasitic infections cause few GI symptoms unless the worm load is heavy. Often patients are unaware of ascaris infections until a worm is passed in the stool or accidentally vomited or coughed up. E vermicularis (pinworm) infections in childhood are common and typically produce pruritus ani, especially at night when the female worm leaves the rectum to lay eggs on the perianal skin."

6. Joshua's diarrhoea continues and he is assessed to be 5% dehydrated. Outline the key clinical features of mild, moderate and severe dehydration.

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Assessment of dehydration (from Roberton, table 20.2.3, p. 724)

Child doesn't look too bad
THIRSTY

Mild (=< 5% body weight loss)

Dry mucous membranes
Decreased peripheral perfusion*
Thirsty, alert, restless

Moderate (6-9% body weight loss)

Starting to look unwell
CLINICAL SIGNS

Exaggeration of the above
Lethargic but irritable
Rapid pulse, normal blood pressure
Sunken eyes, sunken fontanelle
Oliguria is usually obvious
Pinched skin retracts slowly (1-2 s)*

Severe (>= 10% body weight loss)

Looks v sick

General appearance
Infants: drowsy, limp, cold, sweaty, cyanotic limbs, comatose
Older children: apprehensive, cold, sweaty, cyanotic limbs

CLINICAL SIGNS + COMPENSATION

Rapid feeble pulse, low blood pressure
Sunken eyes and fontanelle
Pinched skin retracts slowly (>2s)*
Deep acidotic breathing*

- **These are the only signs proven to discriminate between hydration and dehydration.**

7. Outline a management plan for Joshua at his current level of dehydration.

Assuming other emergencies are excluded, a trial of fluid would be instituted. If Joshua was tolerating fluids well, and attentive and supportive parents/guardians are assured, then he could be allowed home with education and advice about fluid & nutritional management, as well as a thorough discussion of the circumstances that should prompt a return to hospital. Joshua should otherwise be reviewed by a GP within 24 hours, with a letter outlining the details of his casualty visit. Handwashing and careful hygiene are also emphasised for those caring for the infant.

Oral rehydration solution (ORS) is the cornerstone of successful rehydration and is recommended globally for the management of acute diarrhoea. The success of ORS is based on the basic observation that intestinal sodium transport is enhanced by glucose transport in the small intestine and that this sodium-coupled mechanism for glucose transport remains intact during acute gastroenteritis.

To facilitate optimal reabsorption of sodium, glucose and water, the sodium and glucose must be in the range recommended [around 90 mmol/L for both Na and glucose]

Rehydration should take place over 4-6 hours and can be given orally or, if either vomiting or fluid refusal is a problem, a nasogastric tube may be used to achieve a steady infusion of fluid.

Volume required for rehydration = estimated deficit and maintenance.

Maintenance:

1-3 months of age = 120ml/kg/24h
3-12 months of age = 100ml/kg/24h
12 months onwards = 80 ml/kg/24h

Therefore in this case:

Deficit = 5% of 14kg = 0.7kg = approx. **700ml**
Maintenance = 80ml x 14kg = **1120ml** (in 24 hrs)

Therefore total is 700ml + 1120ml = **1820ml over 24 hrs.**

If replaced orally, deficit can be replaced over hrs.
Therefore, **in the first six hours** we aim for 700ml + 6/24 x 1120ml = **980ml**
Then maintenance at 1120/24 ml/hr **= approx. 47ml/hr**

Breastfeeding should continue through rehydration and maintenance phases of treatment, and formula feeds need to be restarted after rehydration. Use of special formulas or diluted formulas is unjustified.

Anti-diarrhoeal pharmacotherapy should NOT be used.
Pro-biotics are not currently recommended, though trials underway.
Antibiotics are of use in a limited number of situations for certain pathogens.

8. **Joshua remains unwell and becomes further dehydrated. He is assessed to be 8% dehydrated. Calculate Joshua's fluid replacement regimen for the next 24 hours.**

   Deficit = 8% x 14kg = 1120ml
   Maintenance = 80ml x 14kg = 1120ml (47ml/hr)
   Requires: **2240ml over 24hrs.**

   Can replace **deficit over 6 hrs** = 1120/6 = 187ml/hr.

   Therefore in **first 6 hours give** 187ml/hr + 47ml/hr = 234 ml/hr.
   Thereafter, just **maintenance** @ 47ml/hr

9. **Joshua recovers from this episode and is discharged home. However, he represents on 2 further occasions over the next 2 months with continuing episodes of diarrhoea, there is no vomiting or fever. His mother comments that his stool has not really returned to normal since the initial episode. Outline the key features of your assessment of Joshua.**

   An increase in stool frequency or fluid content is often of concern to parents, but does not necessarily imply significant organic disease, although this needs to be excluded. In every child who presents with chronic diarrhoea, the decision must be made as to whether further investigation is required. The algorithm (below) outlines an approach to the child with chronic diarrhoea.

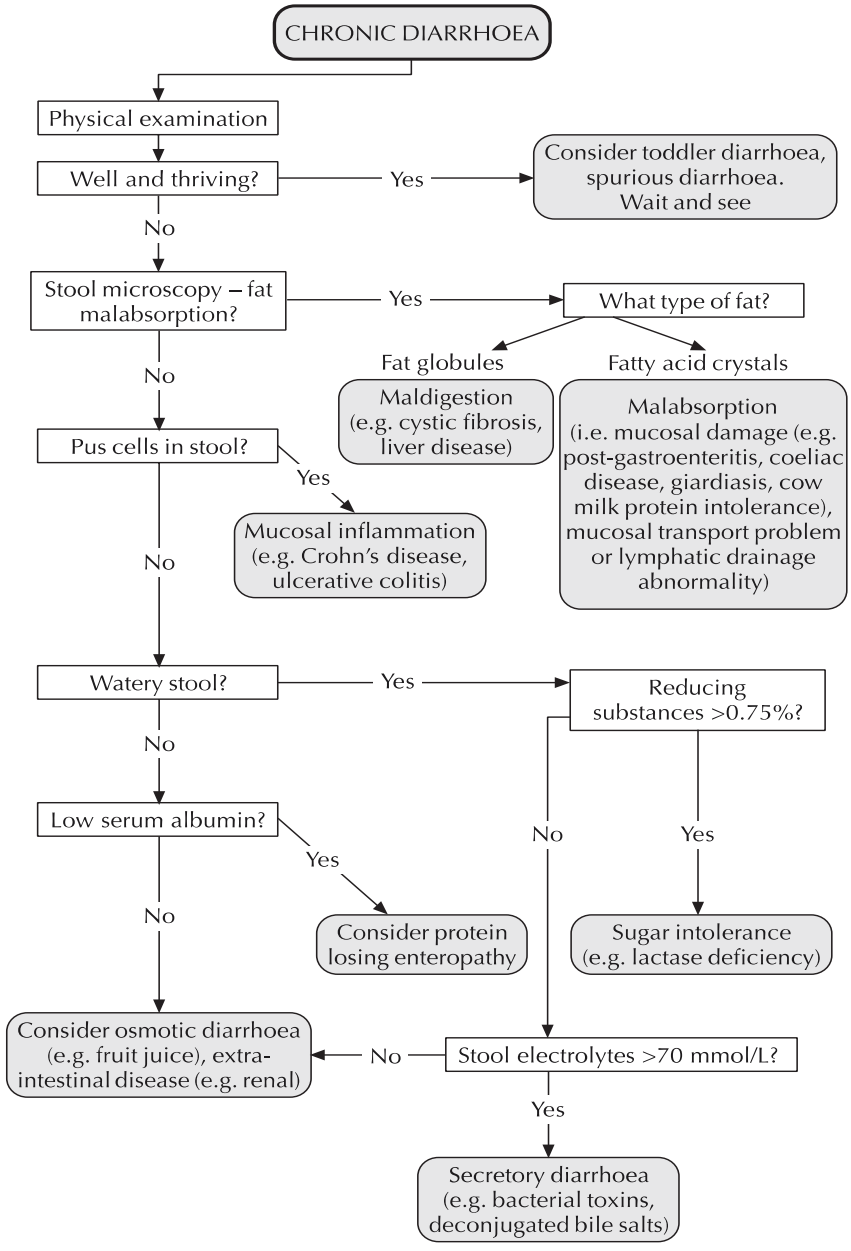

Fig. 27.1 Investigation of chronic diarrhoea

10. Outline the key features of the following conditions: chronic non-specific diarrhoea, post-infective diarrhoea, sucrose-isomaltase deficiency and inflammatory bowel disease.

Chronic non-specific diarrhoea ("Toddler's diarrhoea")

Seen in children between the ages of 12 months and 4 years and current scientific evidence suggests that disturbed intestinal motility is pivotal in the pathogenesis of this condition.

The history is one of frequent, poorly formed and slightly offensive stools. Food material is often recognised in the stool, suggesting rapid gastrointestinal transit. The condition often resolves spontaneously at about 3-4 years of age.

The child is usually active, with unimpaired growth, appetite is normal, and there is a history of increased fluid intake. Further questioning about diet often reveals a high intake of fruit juices and cordial.

The cornerstone of successful treatment includes restriction of fruit juice in the diet, normalising fluid intake and (re-) introduction of wholemeal and other dietary fibres, which add bulk to the stool.

It has also been suggested that many of these children are on a relatively low fat diet, and normalising fat content acts to slow proximal gastrointestinal transit and improve symptoms.

Postinfective diarrhoea

This is defined as the persistence of diarrhoea and failure to gain weight for more than 7 days after hospital admission for gastroenteritis.

It is generally due to a sugar intolerance, which can be confirmed on the basis of stool analysis for reducing sugars and will resolve with elimination of the sugar from the diet.

Other causes include cow's milk protein hypersensitivity or a persistent gastrointestinal infection.

Sucrase-isomoltase deficiency

This is an uncommon inherited disorder (autosomal recessive), with symptoms beginning after sucrose is introduced into the diet.

Symptoms consist of watery diarrhoea and abdominal distension.

Growth is usually normal. Diagnosis is dependent on a positive breath hydrogen test using sucrose as the test sugar.

Alternatively a small bowel biopsy containing very low isomaltase and sucrase levels will establish the diagnosis.

Management is based on dietary restriction of sucrose.

Inflammatory bowel disease

The incidence of Crohn's disease (CD) has increased annually; that of ulcerative colitis (UC) has shown an annual fluctuation without an upward trend. Current opinion regarding the cause of IBD favours the hypothesis that these two conditions result from an interaction between immunological, genetic and environmental factors.

Crohn's disease can present in several ways:

Extraintestinal signs of growth retardation, including anorexia, fatigue, delayed puberty, erythema nodosum, arthritis, clubbing, hepatitis and uveitis

Oropharyngeal involvement includes orofacial granulomatosis and recurrent mouth ulcers.

Gastric and intestinal symptoms, including nausea, vomiting, abdominal pain and diarrhoea.

Oesophageal, gastric and small bowel Crohn's may present as nausea, abdominal pain, vomiting and diarrhoea.

Colonic involvement presents as passage of blood or mucus per rectum.

Perianal involvement includes skin tags, fissures, fistulas and abscesses.

Children with UC will usually present with lower abdominal pain, urgency, diarrhoea and rectal bleeding; additionally:

- systemic symptoms are less marked.
- the child can develop arthritis, which usually correlates with disease activity.
- pyoderma gangrenosum occurs more commonly in UC.
- the child can develop sclerosing cholangitis.

Children may experience the same symptoms, clinical presentations, complications and response to treatment as adults with IBD.

Investigation

Several laboratory tests will point to a diagnosis of IBD; however, endoscopy is the gold standard, however endoscopy is the gold standard. Gastroscopy and colonoscopy (with ileoscopy) is essential, taking biopsies at all levels of the gut, whether or not there is macroscopic disease. Biopsies from a normal appearing stomach or duodenum may contain granulomas, making the diagnosis clear. Pathological alterations above the ileum exclude the diagnosis of UC. A barium meal and follow-through or a labelled white cell scan can be helpful in assessing the area of the gut that is involved in Crohn's disease. Capsule endoscopy is a new and evolving technique that is being used to image the small bowel mucosa.