

Projectile Vomiting

Definition / Supporting Information

Projectile vomiting refers to vomiting that ejects the gastric contents with great force. It is the classic symptom of pyloric stenosis, which is characterised by abnormal thickening of the antropyloric muscles leading to narrowing of the pyloric sphincter.

Projectile vomiting may be the consequence of other conditions which should be excluded in the history, examination and investigation. This topic focuses primarily on pyloric stenosis, with reference to important differential diagnoses. Vomiting is described separately.

Pyloric stenosis affects 2–4 per 1,000 newborn babies, is nearly 4 times more common in boys and may run in families [[NHS Inform](#); [Patient](#)]. It is successfully treated by incision through the hypertrophied pyloric muscle (pyloromyotomy) [[Patient](#)].

Keywords / also known as: emesis, forceful vomiting, hypertrophic pyloric stenosis, intestinal obstruction, severe vomiting

Essential History (Pyloric stenosis)

Ask about:

- Onset of vomiting
 - Symptom onset is typically 3–6 weeks of age in a full-term infant; however, has been reported in newborns and older infants
- Pattern and frequency of vomiting
 - Initially a small amount of vomit immediately after a feed, with weight gain unaffected initially
 - Vomiting becomes more frequent and projectile after a few weeks, and after every feed and with associated weight loss
 - The infant continues to be hungry immediately after vomiting
- Colour of vomitus
 - The vomit of pyloric stenosis is non-bilious, but may become coffee-ground colour as gastritis and bleeding develops
- Behaviour
 - In pyloric stenosis, infants seem well initially despite the vomiting, but may become lethargic and have fewer wet nappies as they become dehydrated
- Family history
 - Strong familial association in pyloric stenosis
 - Occurs in 5% boys and 2.5% girls whose fathers had pyloric stenosis
 - Occurs in 19% boys and 7% girls whose mothers had pyloric stenosis
 - Concordance
 - Monozygotic twins: 0.25–0.44

- Dizygotic twins: 0.05–0.1
- Ethnicity
 - Pyloric stenosis is more common in Caucasians

‘Red Flag’ Symptoms and Signs

Ask about:

- Bilious vomiting
 - In a neonate, consider bowel obstruction (see Acute Surgical Abdomen)
 - A sign of intestinal obstruction requiring urgent referral and assessment to a paediatric surgeon
- Drowsiness / irritability
 - Meningitis
 - Intracranial disease
- Fewer wet nappies or stools
- Weight loss
- Gastro-oesophageal reflux (GOR) (see Gastro-oesophageal reflux disease (GORD) in children and young people: diagnosis and management [[NICE guideline NG1](#)] and GORD in children [[NICE clinical knowledge summary](#)])
- Fever
- Sepsis (neonatal)

Look for:

- Significant weight loss
- Signs of dehydration (eg, sunken fontanelle, lethargy)
- An enlarged pylorus may be felt as a firm, mobile, ovoid-shaped mass in the right upper quadrant or epigastrium of the abdomen at the lateral border of the rectus abdominis muscle – the ‘olive’ – during a ‘test-feed’
- Visible ripples which move across the abdomen from left to right approximately 30–40 minutes post feed (stomach wall peristalsis)

Differential Diagnosis / Conditions

- Sepsis
- Bulging fontanelle and irritability are signs of central nervous system (CNS) involvement (eg, meningitis)
- Urinary tract infection (see Urinary tract infection in children: Diagnosis, treatment and long-term management [[NICE clinical guideline CG54](#)])
- Otitis media
- Viral gastroenteritis
- Intracranial disease
- Consider malrotation in an infant with bilious vomiting
- Consider other causes of gastric outlet obstruction in an infant with non-bilious vomiting:
 - Foregut stenosis
 - Gastric duplications

- Antral webs
- Pylorospasm
- Annular pancreas
- In an infant with persistent vomiting and a normal ultrasound and upper gastrointestinal (GI) tract study consider:
 - Overfeeding
 - Cow's milk protein allergy (see Food allergy in under 19s: assessment and diagnosis [[NICE clinical guideline CG116](#)] and Cows' Milk Protein Allergy in Children [[NICE Clinical Knowledge Summary](#)])
 - Gastroesophageal reflux disease (see Gastro-oesophageal reflux disease in children and young people: diagnosis and management [[NICE guideline NG1, Recommendations 1.1](#)])
 - Renal disorders
 - Adrenal insufficiency (congenital adrenal hyperplasia (salt-losing))
 - Congenital adrenal hyperplasia (salt-losing)
 - Suspect in the presence of:
 - Abnormal genitalia
 - Hyponatraemia
 - Hyperkalaemia

Investigations

To be undertaken by non-specialist practitioners (eg, General Practitioner (GP) Team):

- Feel for thickened pyloric muscle
 - During feeding, may present as a small, hard lump on the right side of the stomach
- Examine during a feed to observe any vomiting
- Test urine in children with vomiting and fever as recommended in Urinary tract infection in under 16s: Diagnosis and management [[NICE clinical guideline CG54](#)]
- Refer to secondary care if needed

To be undertaken by specialist practitioners (eg, Paediatric / Paediatric Surgery Team(s)):

Pyloric stenosis

Diagnostic Approach

- A positive 'test-feed' alone will aid with an accurate diagnosis in most infants
- A 'test-feed' can be performed to palpate the enlarged pylorus, which is felt in the epigastrium as a firm, mobile, mass (the 'olive')
 - Ask the parent to feed the infant positioned with knees flexed to relax the abdominal muscles and feet elevated
 - Place 2 / 3 fingertips in the right upper quadrant, gently advance into the deeper tissues below the liver edge, and then slowly sweep toward the umbilicus: the mass will be felt to roll under the fingertips during this sweeping motion

- The mass is best felt immediately after an episode of projectile vomiting when the pylorus is fully contracted and firm
- The mass will be difficult to palpate in an agitated, crying infant with a contracted abdominal wall
- If the mass is not felt with the infant in the supine position, it can be helpful to try palpating whilst the infant is lying prone
- Occasionally, it may be necessary to:
 - Pass a nasogastric tube
 - Empty the stomach
 - Feed the infant small quantities of dextrose in water to help relax the abdominal wall
- Stomach wall peristaltic contractions, which move across the upper abdomen from left to right, may be seen in some infants and are best seen with a bright light directed across the abdomen from the infant's side

Laboratory tests

- Hypochloraemic, hypokalaemic metabolic alkalosis is a hallmark of pyloric stenosis caused by loss of gastric hydrochloric acid from persistent vomiting and increased renal excretion of potassium from increased aldosterone production due to dehydration
- A reduction in chloride in the blood leads to an exchange of hydrogen and potassium for sodium in the distal tubule, leading to paradoxical aciduria
- Hypoglycaemia may occur and if severe may cause seizures
- Unconjugated hyperbilirubinaemia is common due to a decrease in hepatic glucuronyl transferase activity; this is transient and resolves with treatment

Imaging

- Ultrasonography is a more reliable technique than a 'test-feed' (sensitivity approaching 100%) to confirm a pyloric stenosis diagnosis
 - Pyloric muscle wall thickness ≥ 3.7 mm and a channel length ≥ 17 mm have been shown to have $\geq 90\%$ positive predictive value (Figure 1)
 - Diagnostic criteria for wall thickness may be reduced to 3 mm in infants < 30 days
- Upper gastrointestinal tract (GI) tract contrast study
 - May be performed when ultrasonography is not diagnostic
 - Characteristic upper GI tract findings in infants with pyloric stenosis include
 - String sign: the elongated and narrowed pyloric channel
 - Hypertrophied pylorus bulging into the gut lumen (Figure 2)



Figure 1. Abdominal ultrasound showing abnormal thickening (4.5 mm) of pyloric wall consistent with pyloric stenosis

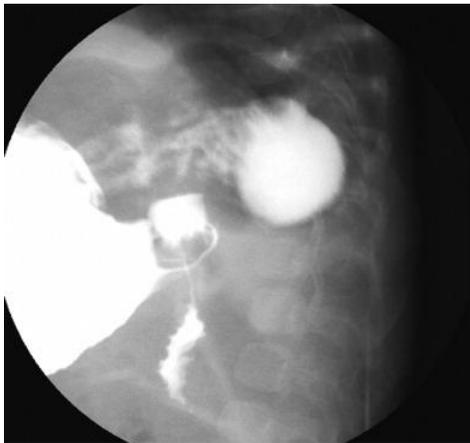


Figure 2. Upper gastrointestinal study showing a narrow and elongated pyloric channel with a double-track appearance consistent with pyloric stenosis

Other causes of gastric outlet obstruction

- Abdominal x-ray
- Upper GI contrast study

Malrotation

- Upper GI contrast study

Intracranial disease

- Computed tomography (CT) or magnetic resonance imaging (MRI) of the head

Treatment Approach

To be undertaken by specialist practitioners (eg, Paediatric / Paediatric Surgery Team(s)):

Pyloric stenosis

- Management includes correction of dehydration and pyloromyotomy
 - Stabilisation should be undertaken by the Paediatric Team with prompt referral to Paediatric Surgery Team

Specific treatments

- The priority is correction of fluid deficit and electrolyte imbalance in preparation for surgery
- Infants who have surgery with an uncorrected alkalosis may experience worsening electrolyte abnormalities due to the profound stress of surgery on urinary excretion of sodium
- Replace fluids to include correction of deficit and daily maintenance volumes
 - Maintenance infusion of 5% glucose / 0.9% sodium chloride
 - Add 20 mmol/L potassium chloride once urine output resumes
 - Give boluses of 0.9% sodium chloride at 20 mL/kg to achieve a serum chloride level of 100 mmol/L
- Place a wide-bore nasogastric tube on free drainage to decompress the stomach and monitor aspirate volume

Surgical management

- Ramstedt pyloromyotomy (via a right upper quadrant transverse incision) is a reliable and safe technique for hypertrophic pyloric stenosis
- Alternative approaches include:
 - Circumumbilical
 - Laparoscopic
 - This has the advantage of shorter average operative time without additional complications or cost
 - Evidence from randomised controlled trials shows lower incidence of wound-related complications, reduced time to full feeding and shorter length of postoperative stay

Postoperative management

- Postoperative vomiting is common and usually resolves after a few feeds (parents should be counselled about this prior to surgery)
- Infants can be fed full-strength formula or breast milk every 3–4 hours starting approximately 6 hours after surgery
- Infants can be refeed the amount vomited approximately 1 hour later, and then continue with the feeding schedule; early refeeding shortens the postoperative hospital stay
- Infants can usually be discharged 24–48 hours after surgery once feeds are tolerated
- Consider need for short term pain relief
- Provide reassurance and advice to parents on wound care and bathing

Medical management

- Rarely indicated
 - May be considered as an alternative to pyloromyotomy in children with major concurrent primary disease

When to Refer

Refer urgently to specialist practitioners (eg, Emergency Department / Paediatric Team(s)) if:

- Projectile vomiting + / – ‘Red Flags’
- Bilious vomiting

Escalate care to Paediatric and Neonatal Surgery Team if:

- Pyloric stenosis has been confirmed
- Other causes of gastric outlet obstruction or malrotation are suspected

‘Safety Netting’ Advice

- If seen by GP / emergency department and discharged home:
 - Advise parents to return if vomiting persists or concerns about fewer wet nappies, infant less alert
 - If above investigations prove inconclusive, and infant is discharged home, arrange follow-up with paediatric team in 7–10 days
- Provide parents / carers with direct access if an assessment is needed sooner

Patient / Carer Information

****Please note: whilst these resources have been developed to a high standard they may not be specific to children***

- [Diarrhoea and vomiting](#) (Web page), the NHS website
- [Gastroenteritis in children](#) (Web page), the NHS website
- [Gastroenteritis in children](#) (Web page), Patient
- [Nausea and vomiting](#) (Web page), Patient
- [Reflux in babies](#) (Web page), the NHS website
- [Vomiting in children and babies](#) (Web page), NHS Inform

Resources

National Clinical Guidance

[Food allergy in under 19s: assessment and diagnosis](#) (Web page), NICE clinical guideline CG116, National Institute for Health and Care Excellence

[Gastro-oesophageal reflux disease: recognition, diagnosis and management in children and young people](#) (Web page), NICE guideline NG1, National Institute for Health and Care Excellence

[Neonatal infection \(early onset\): antibiotics for prevention and treatment](#) (Web page), NICE clinical guideline CG149, National Institute for Health and Care Excellence

[Meningitis \(bacterial\) and meningococcal septicaemia in under 16s: recognition, diagnosis and management](#) (Web page), NICE clinical guideline CG102, National Institute for Health and Care Excellence

Suggested Resources

****Please note: these resources include links to external websites. These resources may not have national accreditation and therefore PCO UK cannot guarantee the accuracy of the content.***

[Dehydration](#) (Web page – requires log-in), Spotting the Sick Child

[Gastroenteritis](#) (Web page), NICE clinical knowledge summary, National Institute for Health and Care Excellence

[GORD in children](#) (Web page), NICE clinical knowledge summary, National Institute for Health and Care Excellence

[Nausea and vomiting](#) (Web page), HeadSmart: be brain tumour aware

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