SURGICALLY CORRECTABLE CAUSES OF VOMITING IN INFANCY

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Surgically correctable causes of vomiting in infancy

Infants up to one week old

- Gastrointestinal atresias
- Malrotation
- Meconium ileus
- Hirschsprung's disease

Infants up to one month old

- Gastro-oesophageal reflux
- Pyloric stenosis

Infants up to one year old

- Intussusception
- Inguinal hernia

Surgically correctable causes of vomiting in infancy are unusual, but an awareness of this possibility is important in order to prompt appropriate referral and management. It is possible to consider the various conditions by the age of the infant.

Clinical features suggesting a surgically correctable cause of vomiting

- Bile stained vomit
- Localised or asymmetric tenderness
- Abdominal distension

First week of life—in the postnatal ward

Radiograph showing nasogastric tube curled in upper pouch of oesophageal atresia (arrow) and large isolated stomach bubble caused by an associated duodenal atresia.

Oesophageal atresia

Infants with oesophageal atresia may well present on the postnatal ward or delivery suite with regurgitation of saliva, although clearly this is not strictly vomiting. Such babies are characteristically described as mucousy or bubbly, and there may have been a history of maternal polyhydramnios. The clinical diagnosis can be confirmed by attempting to pass a large nasogastric tube (8-10 French gauge) and then taking an x ray picture of the chest. Smaller gauge tubes may well coil in the upper pouch.

Gastrointestinal atresia

Almost all upper gastrointestinal atresias such as duodenal or jejunal atresia present on the first or second day of life. The key clinical feature is vomiting of bile, and this certainly requires a surgical review. Polyhydramnios may again have been a feature during pregnancy, and in some infants prenatal vomiting of bile may mimic meconium stained liquor. Even the absence of bile from the vomit does not exclude duodenal atresia, as some 15% of even complete duodenal occlusions are supra-ampullary. Unlike other causes of a high intestinal obstruction, up to 30% of infants with duodenal atresia also have Down's syndrome.

Jejunal atresia.

Incomplete upper gastrointestinal obstructions

These can be less clear cut, and successful feeding may become established with perhaps only occasional vomiting. Such diagnoses include duodenal stenosis and midgut malrotation. Most stenoses and about half of all malrotations present in the neonatal period. Every clinician caring for infants should certainly be aware of midgut malrotation, which is caused by failure of the developing bowel to complete the usual anticlockwise rotation. The usual arrangement of bowel in a malrotation leaves the caecum close to the duodenum. The whole of the midgut loop then arises from a narrow mesentery containing the axial mesenteric blood supply. A volvulus of the small bowel is possible and can be catastrophic. The duodenum may still be intermittently obstructed even in the absence of volvulus.

Radiograph after barium meal showing right sided jejunal loops of malrotation.

Radiograph showing double bubble appearance of duodenal atresia.

First month of life—at home

Radiograph of massive gastro-oesophageal reflux and large hiatus hernia.

Once again, the diagnostic clue is the presence of bile in the vomit. Any suspicion of this condition should prompt testing—either by a careful barium meal and follow through to show the right sided duodenojejunal flexure or in selected cases by ultrasound evaluation of the relative positions of the superior mesenteric vessels.

Distal gastrointestinal obstructions

These may present as failure to establish feeding, vomiting, and distension. The more distal the obstruction the greater the degree of abdominal distension. Usually there is a failure to pass meconium or at least a substantial delay (any longer than 24 hours is abnormal). The two commonest causes of a distal ileal obstruction are ileal atresia and meconium ileus. The second condition occurs in infants with cystic fibrosis and is due to inspissation of viscid meconium in the distal ileum. Bowel loops filled with meconium may be palpable, and the often gross distension may be noted even in the delivery room. These loops are recognisable in radiographs, having a speckled or ground glass appearance (Neuhauser's sign).

Although the bowel in Hirschsprung's disease may seem anatomically intact, there is a functional colonic obstruction. Temporary alleviation of the obstruction can be achieved by digital rectal examination, typically with an explosive gush of flatus and meconium. These infants have defects in the distal enteric innervation characterised by absence of submucosal and intermuscular ganglia and an increase in enteric cholinergic nerve fibres. These histological features are diagnostic and can be obtained by a biopsy of the rectal mucosa and submucosa.

Diagnostic investigations

In most of these conditions the key diagnostic aid is a plain abdominal *x* ray picture. Correct interpretation of the bowel gas pattern is, perhaps surprisingly, accurate and little more investigation may be needed. For example, the "double bubble" appearance is typical of a duodenal atresia. The greater the number of dilated intestinal loops, however, the less specific the diagnosis. In these cases a careful single radiograph after a barium enema may outline the transitional zone of Hirschsprung's disease or the microcolon of a distal ileal obstruction.

Gastro-oesophageal reflux

This is common in maturing infants—the commonly observed possetting being at one end of this spectrum. Generally this is effortless, perhaps positional, usually benign, and improves spontaneously. This can be helped by feed thickening and alginates without any further intervention. In a small proportion of infants, however, reflux can be a considerable problem, leading to failure to thrive and complications such as formation of stricture and oesophagitis. A barium swallow is usually adequate for diagnosis and may show an anatomical cause such as a hiatus hernia. However, the actual degree of reflux can be effectively assessed only by monitoring oesophageal pH for 24 hours.

Treatment—In the absence of complications, drugs such as H_2 receptor blocking agents (for example, cimetidine and ranitidine) and prokinetic drugs (for example, cisapride) are usually effective enough to maintain growth and weight gain. Failure of medical treatment warrants surgery, and an antireflux operation (such as fundoplication) is very effective.

Radiograph showing narrow pyloric canal and large stomach of pyloric stenosis.

Ultrasound scan showing "target" appearance of pyloric stenosis.

Hypertrophic pyloric stenosis (left), during pyloromyotomy (centre), and appearance of circumumbilical incision after successful operation (right).

Pyloric stenosis

Without doubt, the commonest surgically correctable cause of vomiting in infants that most doctors will encounter is pyloric stenosis. It is estimated to occur in about 1 in 400 births, with a distinct male predominance of about 4:1, but the commonly quoted association with firstborn infants is probably an artefact. It is relatively uncommon in black or Asian infants, and there is an unexplained seasonal prevalence in autumn and spring. There is also a strong genetic component, particularly through the maternal line.

These infants will often have successfully established feeding and regained their birth weight, but at about the third or fourth week vomiting will start and swiftly becomes inevitable after every feed. There is work hypertrophy of the obstructed stomach, which explains the characteristic projectility of the vomit. Bile is not seen, of course, but blood, altered or fresh, may be. This is due to an associated oesophagitis. These infants are hungry and eager to feed. The key to the diagnosis is a gentle, patient examination of the abdomen. This is usually best obtained by test feeding the infant, primarily to obtain a relaxed abdominal wall. The pyloric swelling is the shape and size of an olive and is palpable just to the right of the midline. If it is felt no further diagnostic tests are needed: if not, ultrasonography has become increasingly accurate and specific.

Treatment—About two thirds of infants will have the typical metabolic abnormality of hypochloraemic alkalosis. This must be completely corrected with intravenous fluids before an operation can be considered. Ramstedt's pyloromyotomy has been used for over 80 years and is virtually certain to stop the vomiting. There has been recent controversy on the most appropriate approach or incision: although laparoscopic pyloromyotomy has been described in infants, the advantages are not clear compared with the conventional open approach. A periumbilical incision is a recent, more practical, alternative in some paediatric surgical centres and negates the supposed cosmetic advantage of the laparoscopic method.

Outside the neonatal period

Ileocolic intussusception.

Although surgically correctable causes of vomiting are less prevalent in older infants, several conditions must still be considered.

Intussusception

This typically occurs in older infants. There is often a pronounced seasonal variation, suggesting an underlying viral aetiology (adenovirus and rotavirus have been suggested). The most common symptoms of these infants, who are usually boys, are vomiting and apparent abdominal pain (often manifest as inconsolable screaming). The vomiting may become bile stained as a complete small bowel obstruction supervenes. The passage of mixed mucus and blood ("redcurrant jelly") alerts to the condition, but it is a late sign indicating mucosal damage and is present in only 20-30% of cases.

The clinical diagnosis of intussusception can be difficult, with many traps for the unwary. For example, diarrhoea may occur in up to 10% of infants and almost inevitably leads to the diagnosis of infective gastroenteritis. About 10% of patients may present without apparent abdominal pain. Sadly, deaths from this disease still occur in Britain, and among the leading reasons are delays in diagnosis and referral.

Radiograph of large filling defect within colon caused by intussuscepted bowel.

Irreducible right inguinal hernia.

Intussuscepted bowel can be felt as a sausage shaped mass in about half of these infants, typically in the right upper quadrant. Once again, vigorous resuscitation with intravenous fluids should precede any further investigations. Diagnosis may be suggested by a plain radiograph but should be confirmed by ultrasound scanning of the abdomen or by x ray after a barium enema. Most intussusceptions can be reduced without an open operation, either by the older method of hydrostatic reduction with a controlled barium enema or pneumatically with a compressed air enema. There are few contraindications to using these non-surgical methods, although a secondary bowel perforation and peritonitis clearly require a laparotomy.

Other causes of bowel obstruction

There are other causes of small bowel obstruction that may occur in this age group, but by far the commonest (as it is in any age group) are those due an irreducible inguinal hernia. A thorough examination of the groin is mandatory in a vomiting infant. Much rarer intrinsic bowel anomalies include duplication cysts, mesenteric cysts, or a Meckel's diverticulum.

Acute appendicitis

Acute appendicitis occurs rarely in infants, and such children often present late to a surgeon because of the difficulty of diagnosis. There is usually a rapid progression to perforation and peritonitis due to the relative lack of omental tissue in an infant's abdominal cavity. The signs of peritonitis (usually guarding proceeding to overt rigidity) can be seen as well as vomiting in an obviously ill child.

Professor Lewis Spitz, Institute of Child Health, London, provided some of the clinical illustrations.

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NOTHING NEW

Prognostic scoring

Prediction of outcome of disease and risk assessment by a system of scoring has now been widely accepted in modern medicine. The concept is not new. Hippocrates wrote in *Prognostica*, "I hold that it is an excellent thing for a physician to practise forecasting."

Substantial evidence of prognostic scoring was found in an Arabic manuscript—the MS 329 at the John Rylands University of Manchester library entitled *The Sufficient in the Interpretation of the Mujiz*. This was a commentary on the famous treatise *Mujiz* written by Ibn-un-Nafis (died in 1288), chief physician at Cairo's Nasiri Hospital, who also described the pulmonary circulation.

لوحة الحيات						لوحة الكيفية					
٣٨	٥	١٨	٣٥	١٢	٣٨	٣٨	٥	١٨	٣٥	١٢	٣٨
٩	٣١	٣٥	٦	٣٥	١٩	٣٨	٥	١٨	٣٥	١٢	٣٨
٣	٩	١٥	١٥	١٥	٣٩	٣٨	٥	١٨	٣٥	١٢	٣٨

The author of MS 329 was Sadid-Uddin-Alkazruni, who lived during the late 14th century and the manuscript is known as *Sadidi* after the author. Two tables are given (see figure). Each table contains various numbers in three vertical and six horizontal columns. In the resulting 18 boxes Arabic numerals are recorded. The table on the right is assigned to survival of a patient and the table on the left to one who will not survive. The four lines in Arabic text are difficult to read but a broad translation is as follows:

"Some (or a physicians . . . have described a numerical method by which prognosis of death or survival may be made with the help of two tables, one for survival and the other for death. . . . To the total number of days of illness add the number according to Abjed system of patient's and mother's name. Then . . . remaining days of the month and number 40 are added. From the grand total 30 is deducted in a serial fashion. The resulting number is compared with those in the tables and the prediction is made accordingly."

The scoring system described does not seem to be based on any rationality except that the total number of days of illness were taken into account, but it shows that the concept of making prognosis by scoring is not new. The manuscript was copied in 1723 AD in Saharanpur, India.—N H NAQVI is a consultant anaesthetist in Bolton