**ORIGINAL ARTICLE**

**Bilious vomiting in the newborn: 6 years data from a Level III Centre***

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**Background:** Bilious vomiting in the newborn is an urgent condition that frequently requires neonatal and paediatric surgical involvement. Investigations involve abdominal X-ray and contrast imaging in most cases. We aimed to describe the prevalence of surgical intervention in this cohort and assess the reliability of contrast imaging in accurate prediction of underlying condition.

**Methods:** A retrospective audit of data from December 2001 to October 2007 was undertaken. Data on newborns admitted to a level III unit with bilious vomiting was extracted. Infants with bilious aspirates but no vomiting were excluded.

**Results:** Sixty-one infants were admitted to the unit during the period with bilious vomiting. Most of them were out born (83.6%). Mean (and standard deviation) gestation was 38.3 weeks (+3.2); weight was 3173.5 grams (+717.6); day of admission was 3.68 days (1–28); and length of stay in the unit was 9.96 days (1–48). There were 52 (85.2%) abnormal X-rays and 21 (34.4%) abnormal contrast studies. Sixteen (26.6%) babies had laparotomies of which 6 were malrotations with volvulus, 2 small bowel obstructions, 2 meconium ileus, 2 Hirschsprung’s disease, 2 other findings, while 2 were normal. Positive predictive value (number of accurate predictions of surgical findings) for barium contrast studies was 85.7% in this series.

**Conclusion:** Bile stained vomiting is a surgical emergency and prompt investigation is the key in the management. Contrast studies still form the backbone of such investigations.

**Key words:** bile; intestinal obstruction; neonate; vomiting.

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What is already know on this topic

1. Bilious vomiting in newborn age is a medical and surgical emergency.
2. The investigations for this condition include abdominal X-rays and contrast studies.

What this paper adds

1. A case series from an Australian referral neonatal unit is described.
2. The positive predictive value of abdominal contrast imaging is estimated at around 85%.

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**Introduction**

Paediatric surgeons consider bile vomiting in the neonate a potential surgical emergency. Intestinal obstruction is one of the most common causes of bilious vomiting and admission to a neonatal surgical unit, accounting for up to one-third of all admissions.1 It is well known that not all bilious vomiting in a neonate is surgical, though. This paper aimed to study the profile of infants presenting to a level III neonatal unit in Australia with bilious vomiting. This is the first case series reported from Australia. We also wanted to assess the reliability of plain X-ray and contrast imaging in predicting surgical obstruction.

**Methods**

A retrospective audit of data over a 6-year period, from December 2001 to October 2007, was undertaken. Data on newborns admitted to a level III unit (Monash Medical Centre, Clayton, Victoria) with a diagnosis of ‘Bilious vomiting for investigation’ or those who had bilious vomiting while being an inpatient was extracted from the neonatal electronic database. These infants were confirmed to have been identified with a ‘green’ coloured vomiting witnessed by a doctor, midwife or nurse at the referring hospital or at Monash Medical Centre. Infants with bilious aspirates but no vomiting were excluded. Demographic details, investigations and final operative diagnosis were recorded. For infants who were considered to have a surgical cause but did not have an operation in the neonatal period, details from follow-up visits to the surgeons were noted.

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*Presented at the Perinatal Society of Australia and New Zealand Annual Meeting, Gold Coast, Australia, April 2008.

Accepted for publication 10 September 2009.
Specific abnormalities were referrals from other hospitals. Mean gestational age at infants (16.4%) were born in the hospital while the rest of them were noted in 17 infants, and eight (47%) of these needed surgical intervention. Eight (50%) of neonates with surgical findings had features suggestive of lower bowel obstruction (Hirschsprung’s disease?) clinically who went on to have bowel washouts and a rectal suction biopsy which was normal. Of the infants with abnormal contrast imaging who were not operated, three were reported as microcolon, one possible Hirschsprung disease and a further three as meconium ileus. The abdominal condition in all these infants resolved conservatively and follow-up on these infants in the first year of life had not revealed any recurrence of symptoms.

**Results**

Sixty-one infants (33 boys, 28 girls) who were investigated for bilious vomiting were identified during the audit period. Ten infants (16.4%) were born in the hospital while the rest of them were referrals from other hospitals. Mean gestational age at birth was 38.3 weeks (±3.2 weeks, standard deviation) and mean birth weight was 3173.5 grams (±717.6 grams). Mean day of admission to the unit was 3.68 days (1–28, range).

A flow chart of infants with bilious vomiting is shown in Figure 1. Gastrointestinal imaging done was reported by the radiologist and the radiological diagnosis made at the time was noted. All infants had plain abdominal X-rays; however, contrast studies were not done for 8 (13.1%) infants. There were 52 (85.2%) abnormal X-rays and 21 (34.4%) abnormal contrast studies. Barium was used as the contrast agent in all except one infant. Specific findings on the plain abdominal roentgenogram were noted in 17 infants, and eight (47%) of these needed surgical intervention. Eight (50%) of neonates with surgical lesions had normal or non-specific findings on the plain abdominal roentgenograms. Of the 21 infants with abnormal contrast imaging, laparotomies were done in 14 infants. Two infants were identified with conditions not requiring contrast imaging and directly went to laparotomy (ano-rectal malformation, urinary ascites). Hence, a total of 16 (26.6%) infants had laparotomies of which 6 were malrotations with volvulus, 2 small bowel obstructions, 2 meconium ileus, 2 Hirschsprung’s disease (Soave repair), 2 other findings (ascites, adhesions), while the other 2 were normal (incidental appendicectomy done). Positive predictive value (number of accurate predictions of surgical findings) for barium contrast studies was 85.7% in this series. The mean length of stay in the neonatal unit for all the babies was 9.96 days (1–48, range). The sensitivity of plain X-ray to detect intestinal obstructions was 50%, while the specificity was 80%. As far as contrast imaging was concerned, the sensitivity and specificity for picking up intestinal obstructions was 100% and 91%, respectively. (Table 1)

No cause for the bilious vomiting was identified in 38 infants and whose symptoms resolved with conservative management.

Of these, six had a normal clinical examination and a plain abdominal X-ray and did not undergo any further investigation. Abdominal X-ray was reported as ‘non-specific’ in 28 of these infants and abnormal in 10. Five infants with abnormal X-ray findings had features suggestive of lower bowel obstruction (Hirschsprung’s disease?) clinically who went on to have bowel washouts and a rectal suction biopsy which was normal. Of the infants with abnormal contrast imaging who were not operated, three were reported as microcolon, one possible Hirschsprung disease and a further three as meconium ileus. The abdominal condition in all these infants resolved conservatively and follow-up on these infants in the first year of life had not revealed any recurrence of symptoms.

**Discussion**

Standard teaching in paediatrics surgery is that bilious vomiting in a neonate indicates intestinal obstruction until proven otherwise. Bilious vomiting in newborns is an urgent condition that requires the immediate involvement of a paediatric surgeon and neonatologist for perioperative management. First line investigations include detailed clinical examination, a plain radiograph of the abdomen and chest, routine haematology, biochemistry, blood and urine cultures (or full septic screen) if indicated. Dilated bowel loops and air-fluid levels generally suggest surgical obstruction. Depending on suspected pathology, abdominal sonography and gastrointestinal contrast studies are frequently warranted. Duodenal atresia, midgut malrotation and volvulus, jejunoileal atresia, meconium ileus, and necrotising enterocolitis are the most common causes of neonatal intestinal obstruction. However not all cases of bilious vomiting in the neonate are caused by intestinal obstruction.

Bilious vomiting in a neonate is one of the cardinal signs of intestinal obstruction, and paediatric surgeons feel this finding mandates prompt investigation and surgical intervention if necessary. This maxim is supported by cases of previously well neonates with catastrophic midgut ischemia at laparotomy because of small bowel volvulus, where the only abnormal sign in the early stages was vomitus containing bile. There is a questionnaire study that highlights the fact that a number of babies who vomit bile are managed by neonatologists alone and undergo no further investigations while cases managed by surgeons represent a selected minority group. In the study, for neonates with a single bile vomit, most neonatologists would admit to the neonatal unit for further observation and an abdominal X-ray, although 19% felt that continued observation

### Table 1: Reliability of X-ray and contrast imaging in relation to diagnosis

<table>
<thead>
<tr>
<th>Imaging</th>
<th>Surgical cause identified</th>
<th>No surgical cause identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abnormal X-ray (n = 17)</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Normal/non-specific X-ray (n = 44)</td>
<td>8</td>
<td>36</td>
</tr>
<tr>
<td>Abnormal contrast (n = 21)</td>
<td>18</td>
<td>3</td>
</tr>
<tr>
<td>Normal contrast (n = 32)</td>
<td>0</td>
<td>32</td>
</tr>
</tbody>
</table>

![Flow chart of infants with bilious vomiting](image)
on the postnatal ward is appropriate. Paediatric surgical referral was deemed appropriate by 70% of the respondents, but only after admission and X-ray. It is unclear how many would arrange a surgical referral for the patient if no abnormality was discovered. The concern in these cases would be that intestinal ischemia might have developed at the time of the first bile-stained vomit, further delay in appropriate investigation and management could result in critical intestinal loss.

There is also a lot of debate and controversy around the colour and accuracy of picking up ‘green’ bile stained vomiting. In cases of persistent bile vomiting, most neonatologists would advocate transfer to the care of a paediatric surgeon. Malrotation can be present in the older child or in adults and can be associated with significant morbidity and mortality. Establishing a diagnosis early in life offers the possibility of prophylactic surgical intervention, in the form of a Ladd procedure, or a high index of suspicion and prompt intervention in the event of complications if management is expectant. Hence, we would recommend that all infants with bilious vomiting should be referred to the paediatric surgeons for further management in the first instance.

There are only three previously published series of infants with bile stained vomiting. The present series, the first from Australia, reported an incidence of surgical obstruction in 26.6% of cases as compared with 31%, 38% and 51% incidence in the previous studies. Previous literature has suggested that the clinical findings of green vomit, abdominal distension, lethargy, irritability and abdominal tenderness are more likely to indicate the need for surgery. Also noteworthy is that the onset of vomiting and time of first stool passage is not helpful in detecting the need for surgery situation. In fact, there have been instances in which intrauterine bilious vomit has been mistaken for meconium staining of liquor.

Initial routine plain abdominal roentgenogram is helpful in distinguishing infants with surgical or non-surgical problems. The study showed that 47% of infants with a specific finding on plain X-ray had a surgical cause for bilious vomiting. In other words, it confirns that the majority of neonates with bilious vomiting who have normal plain radiographs do not have a surgical lesion; however, the study also indicates that 50% of surgical cases will be missed if contrast studies are not done.

In the absence of clinical signs allowing a positive diagnosis, an upper gastrointestinal (GI) contrast study is recommended to specifically exclude intestinal malrotation and volvulus. These maxims are based on the experience that 30% to 40% of neonates that vomit bile require surgical intervention. However, as most neonates are born outside paediatric surgical centres, the cohort of patients being investigated and treated represents a selected group based on the discretion of the referring neonatologist. A policy of more aggressive investigation raises issues about the management of babies with borderline contrast findings. In the present study, seven infants with abnormal contrast imaging did not go on to have an operative procedure.

The interpretation of contrast imaging is vital to the management. The position of the duodenal–jejunal flexure shows some variability in the neonate, and the ramifications of a false-positive finding would be unnecessary surgery. A prospective study of upper GI contrast studies in all babies with bile vomiting would help to further investigate this question. In the meanwhile, it would be prudent to organise an upper gastrointestinal imaging for all cases of bilious vomiting after consultation with the paediatric surgeon. This is supported by the finding of high sensitivity and specificity of contrast imaging with a reasonable positive predictive value of accurate surgical diagnosis in this series.

The present study does have some limitations. We did not include patients with delayed passage of meconium in the cohort, and there might have been some cases with Hirschsprung’s disease missed which would have had bilious vomiting but were not entered on the database as an admitting diagnosis. This might also explain the low incidence of Hirschsprung’s disease in this series (4.9%). Also it would have been ideal to have the radiological diagnosis reported initially confirmed by a blinded observer. The high positive predictive value of contrast imaging might have been over estimated because of the fact that seven of the 21 infants with abnormal contrast imaging did not go to surgery.

To conclude, the age remains pertinent that ‘bile vomiting in infancy represents intestinal obstruction until proven otherwise.’ Paediatric surgeons and neonatologists should be involved in the management of such infants and contrast imaging organised to rule out malrotation as soon as possible.

References