Low incidence of surgical pathology in infants with bilious vomiting

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Research Article

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Abstract

Background: Bilious vomiting in the neonate is an important presenting sign of intestinal obstruction. We conducted a review of the presentation and management of term neonates admitted with bilious vomiting (BV) to determine the incidence of a surgical pathology in our population.

Design: Retrospective cohort study using a prospectively maintained database.

Participants: All term infants admitted to NICU with BV at the Royal Women's Hospital Melbourne during a 5-calendar year period.

Results: All 153 babies had at least one imaging study. 128 (83.7%) had plain abdominal radiographs. 127 (83%) underwent upper gastrointestinal contrast scan (UGI) and 103 (67.3%) had both. 6 (3.9%) UGI studies were abnormal, with 3 babies (1.9%) subsequently having surgical pathology (2 volvulus, 1 Hirschsprung disease). Only 6 (3.9%) babies in our cohort had a surgical pathology identified (4 Hirschsprung disease, 2 malrotation). Babies with surgical pathology were more likely to present later (median 40 hours versus 23 hours). Abdominal distension was highly sensitive for surgical pathology.

Conclusion: The incidence of surgical pathology in this cohort was low compared to other studies. It is more likely in infants presenting with BV after 24 hours.

Introduction:

Bile is a luminous yellow fluid produced by the gall bladder. It drains into the duodenum via the biliary tree and is not normally present in vomitus unless forward intestinal flow is obstructed. Bilious vomiting (BV) presents clinically as green vomitus, secondary to the action of gastric acids. Surgical teaching dictates that BV is secondary to intestinal obstruction, either mechanical or functional, until proven otherwise.[1]. It may be the only symptom in infants with intestinal malrotation, and catastrophic gut ischaemia and death can occur if not treated promptly [1] with mortality as high as 4% for neonates with volvulus.[2]. The reported proportion of neonates with BV who subsequently have a surgical pathology identified varies between 20 and 50%.[3–6]. However, the actual incidence of BV with or without a surgical diagnosis in term infants is unknown.[7]. Malrotation is a congenital cause of BV with an incidence of 1:6000 births.[1]. Abnormal fixation of the small bowel in malrotation can compromise the blood supply to the whole intestine as the root of the mesentery is on a thin stalk prone to twisting (volvulus), vascular obstruction and gut ischaemia.[1]. 30% of neonates with malrotation present within 3–7 days, and 80% by 1 month, indicating that many cases will present after discharge from hospital.[7]. One study reported that 15% of term infants less than 7 days old transferred by the London Neonatal Transport Service were for BV.[8]. An upper gastrointestinal contrast study (UGI) remains the best available radiological investigation for diagnosing malrotation with a positive predictive value of 90% [2], although ultrasonography has also been shown to be safe and reliable.[9–11].

We observed a high rate of admission to the NICU with BV and reviewed the presentation, management and subsequent outcomes, to determine the incidence of surgical pathologies in this population.

Methods:

All inborn term neonates 37 weeks' gestation or more admitted to NICU from 1 January 2015 to 31 December 2019 were identified through a prospectively maintained database where the principal or secondary reason for admission was 'vomiting'. Only infants with BV, defined as any green-stained vomit, were included. Clinical data were collected from the clinical record, including demographic details, feeding at presentation, age at passage of meconium, colour and number of vomiting episodes, and whether the infant was clinically unwell at presentation. Data were collected on radiological investigations (abdominal plain radiographs [AXR] and UGI studies), laboratory tests and the duration of antibiotic therapy. We recorded if the infant was transferred to a surgical centre for further investigation or management.

Statistical Analysis:

Statistical analysis was performed using Microsoft Excel version 16.37 and R Version 4.0.0 (R Foundation for Statistical Computing, 2020). Median and range were determined for non-normally distributed data, with mean and standard deviation (SD) calculated for normally distributed data. A Mann Whitney U Test was performed to compare non-normally distributed populations. This audit was approved by the Royal Women's Hospital Human Ethics and Research Committee as a quality assurance activity AQA21/02.

Results:

Clinical presentation:

Over this 5-year period, 33957 term infants were liveborn in our institution. 153 infants with BV were admitted to NICU, giving a prevalence of 4.5 per 1000 live births. 66.0% had an isolated episode of BV. Whilst there was variation in the description of the colour of the vomitus, all were documented as "green". 55.6% of infants were male. The median age at presentation was 23 hours (range 4-168 hours). The mean (SD) gestational age was 39^{+4} (± 1^{+2}) weeks and mean birth weight was 3446 (± 439) grams. Six infants (3.9%) were readmitted after initial discharge, at a median of 59 hours (range 32-168 hours). Five babies (3.2%) first passed meconium more than 24 hours after birth. 83.7% of babies were exclusively breastfed at presentation. The characteristics of the cohort is summarised in table 1.

Two infants in our cohort were diagnosed with intestinal malrotation, giving an incidence of 1.3% and prevalence 0.06 per 1000 live births. These infants presented at 40 and 42 hours of age, respectively. Four infants were diagnosed with Hirschsprung disease giving an incidence of surgical pathology of 3.9%. The median age of presentation in infants with pathology was 40 hours, (range 20 to 168 hours), whereas the median age in infants without surgical pathology was 23 hours (range 4 to 96 hours, p=0.04).

Infants who required respiratory or cardiovascular support (such as fluid resuscitation) on presentation or who had an abnormal clinical examination or vital signs were classified as ‘clinically unwell’. Eleven babies (7.2%) fulfilled these criteria, 6 of whom also presented with a distended abdomen and subsequently were diagnosed with a surgical pathology. All eleven were screened for infection and treated with benzylpenicillin and gentamicin for possible early onset neonatal sepsis. These clinical criteria identified all infants with surgical pathology (Table 1).

Radiological findings:

Investigations and management are shown in Table 2. 83.7% underwent AXR with 5.2% reported as abnormal. UGI contrast was performed in 83.0%, with 3.9% reported as abnormal. Radiological investigations and the outcomes are summarised in Figure 1.

Of the 6 babies identified with surgical pathology, 6 had an abnormal AXR and 3 of 4 undergoing UGI contrast had an abnormal study. 3 babies without subsequent surgical pathology had an abnormal UGI contrast. 1 had a normal diagnostic laparoscopy, 1 had a repeat UGI which was normal and the other had an AXR post-UGI which showed normal transition of contrast to the rectum, so feeds were reintroduced without any problems.

The PPV and NPV for predicting surgical pathology with AXR were 75% and 100%, respectively. For UGI values were 50% and 99.2% (one baby who subsequently had Hirschsprung disease had a normal UGI).

Some babies (n = 23, 19.2%) with BV who had a normal plain radiograph were not referred for UGI studies, with clinical staff appearing reassured by normal clinical and plain radiography examinations. In 18 of these babies, the BV was an isolated event and feeding was recommenced after a period of observation. None of these babies subsequently presented to the tertiary children’s hospital following discharge with further episodes of BV.

73 (47.7%) infants were transferred from our institution to a children’s hospital for further investigation or management. Whilst an UGI study can be performed at our site, it is dependent on the availability of a radiologist with experience in interpreting neonatal UGI studies. 7 babies (9.6%) were transferred for a surgical opinion (1 abnormal UGI at RWH, 6 had clinical signs). The others were transferred for imaging.

Antibiotic therapy:

141 (92.2%) babies had a blood culture taken and were commenced on antibiotic therapy. Five babies (3.5%) had a positive blood culture (four coagulase-negative staphylococcus [CONS] and one streptococcus species) with four receiving a treatment course of 5 or more days. All had a CRP above 10mg/L but none presented as “clinically unwell” and the positive blood culture results were considered likely to be contaminated samples rather than true bacteraemia.

Discussion:

This study describes a cohort of term infants presenting to a non-surgical perinatal centre with BV and demonstrates a low incidence of surgical pathology (3.9%) compared to that previously reported in the literature (50%).[3]. Most paediatric surgical centres receive referrals of infants with BV for further management from a large number of non-specialist hospitals, including infants with clear surgical signs and those who are clinically unwell. This may explain the higher incidence of surgical pathology demonstrated in these studies.[3–6, 8]. Our study was population-based from a single centre from a cohort of 'well / normal' term infants, therefore unlikely to have a high incidence of underlying pathology. The prevalence of malrotation was much lower in our study (0.06 per 1000 births) compared to that quoted in the literature (0.17 per 1000 births).[1]. Such prevalence statistics are calculated from whole populations from multiple centres, whereas our study was from a single centre. Whilst we have calculated the incidence of BV in a population of inborn infants, some infants may have been discharged from our hospital and presented directly to another hospital. Review of infants who did not undergo UGI imaging did not reveal any presenting to the local Children's Hospital surgical service with a subsequent surgical diagnosis. However, our estimate of the prevalence of BV and surgical diagnosis is approximate as others may have presented via the emergency department of the local Children's Hospital.

The most significant predictor of surgical pathology in this cohort was abdominal distension, with 100% specificity. Similar findings have been reported in other studies.[3, 5]. Four infants in this cohort were diagnosed with Hirschsprung disease, all presenting with abdominal distension and BV and typically after 48 hours. Although delayed passage of meconium on its own did not predict surgical pathology in our cohort, Hirschsprung disease is typically characterised by this in combination with abdominal distension.[12]. BV can also be a cardinal sign.[12]. Any infant presenting with abdominal distension and BV should be investigated promptly and referred to a surgical service as necessary.

Clinical recognition of BV may be difficult.[13]. Whilst most clinicians appreciate that 'bile stained' vomitus is abnormal, there can be confusion about what colour indicates bile-staining.[13]. The introduction of a chart including the colour of vomitus and the appropriate escalation path in our hospital identifies infants who require review. Consideration should be given to raising awareness of BV amongst inexperienced clinicians and midwives.

Our results suggest that timing of presentation may be important. A UK prospective audit of neonates with BV reported a median age of presentation of 26 hours [4], which is comparable to our cohort. These were infants referred to a surgical service therefore results demonstrated a much higher incidence of surgical pathology. Although they did not specifically look at the age of presentation in those with surgical pathology versus those without, it does demonstrate a trend toward surgical pathology being more likely if presenting after 24 hours. Only two infants in our cohort were diagnosed with malrotation, both presenting after 24 hours, which is consistent with other reports in the literature.[7]. Our findings demonstrated that infants with surgical pathology were more likely to present later.

It may be that BV in the first 24 hours is more common than has been appreciated and – in the absence of abdominal distension or clinical signs of an unwell infant – is more likely to be benign rather than due

to a surgical cause. 55% of our cohort presented at 24 hours or less and only one infant had a surgical diagnosis (1.8%). This infant presented with abdominal distension and was diagnosed with Hirschsprung disease. Previous evidence suggests that the yield of positive UGI contrast studies, and surgical pathology, is greater after day 2 in infants referred with BV [7], consistent with our study. An Australian study of infants referred to a surgical centre with BV reported a mean age of admission of three and half days and a higher incidence of surgical pathology of 26.6%.[6]. This, again, could indicate that babies with surgical pathology are more likely to present later. Regardless, although most infants with BV will not have a pathological cause identified [6], investigation to exclude an underlying surgical condition (particularly malrotation) is recommended. Even though some would not consider referral for UGI after a single BV [14], our review identified that all infants underwent either AXR, UGI contrast or both (Fig. 1).

Our study raises the question of the usefulness of plain radiographs in clinically well infants with BV and whether investigation with UGI contrast alone would suffice. Specificity and sensitivity scores for identifying a surgical or time critical diagnosis with UGI contrast studies have been reported at over 90%, whereas scores were much lower for plain abdominal radiographs [3], with specificity as low as 14% for surgical pathology.[5]. Normal plain radiographs are usual in malrotation [1] and could potentially be avoided in preference for an UGI contrast if the sole diagnosis to exclude is malrotation. Ultrasound may be an alternative investigation for detecting malrotation.[9–11]. The presence of the ‘whirlpool sign’ along with inversion of the superior mesenteric artery and superior mesenteric vein on ultrasound, has accuracy up to 100% for diagnosis of malrotation.[11]. However, as with any radiological investigation, the availability of experienced sonographers to scan babies with a potential time critical diagnosis remains a limitation of ultrasound.

92% of our cohort received antibiotics as part of their management, with 67% discontinuing after 48 hours. In the majority of cases the only documented indication was BV. There is no clear evidence that BV alone is a feature of early onset neonatal sepsis, particularly in a “well” infant.[15]. Clinicians should consider whether antibiotics are necessary in “well” term infants with BV where the only question is “do they have malrotation?”

Conclusion:

This study from a non-surgical NICU showed a low incidence of surgical pathology (3.9%) in term infants admitted with BV. Infants with surgical pathology are more likely to present after the first 24 hours. Clinical signs, especially abdominal distension, were the most sensitive predictor for pathology. However, UGI contrast studies to exclude malrotation should be performed in any infant presenting with BV.

Abbreviations:

BV – Bilious vomiting

UGI – Upper gastrointestinal contrast scan

AXR – Abdominal plain radiograph

NICU – Neonatal intensive care unit

CONS – Coagulase negative staphylococcus

What Is Already Known On This Topic:

- BV is a common presenting feature of intestinal malrotation.
- UGI contrast studies are the best available investigation for diagnosing malrotation.
- Timing of presentation of BV is not fully understood.

What This Study Adds:

- Low incidence of surgical pathology in infants with BV from a non-surgical perinatal hospital.
- Surgical pathology was more likely in infants who presented after 24 hours.
- Abdominal distension is a more sensitive predictor for surgical pathology than BV.
- In clinically-well term infants with BV without abdominal distension, UGI contrast may suffice.
- More than 50% of babies with BV presented within the first 24 hours.

Declarations:

Funding:

No funding was required to complete this study.

Competing interests:

DC reports no competing interests. CK reports no competing interests.

Availability of data and material:

Not applicable

Code availability:

Microsoft Excel version 16.37 and R Version 4.0.0 (R Foundation for Statistical Computing, 2020)

Contributorship statement:

DC worked as a neonatal fellow at RWH from August 2019 to August 2020. He collected / interpreted data, and wrote the manuscript. CK established the cohort of patients, advised and assisted with data interpretation and made edits to the manuscript. We are grateful for the assistance of Dr Leah Hickey at

the Royal Children's Hospital, Melbourne, with collecting data about outcomes of babies transferred for surgical review.

Ethics approval:

Granted by the ethics department at RWH.

Consent to participate:

Not applicable

Consent for publication:

All authors consent to the publication of this work.

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Tables

Due to technical limitations, Tables 1 and 2 are only available as a download in the Supplemental Files section.

Figures

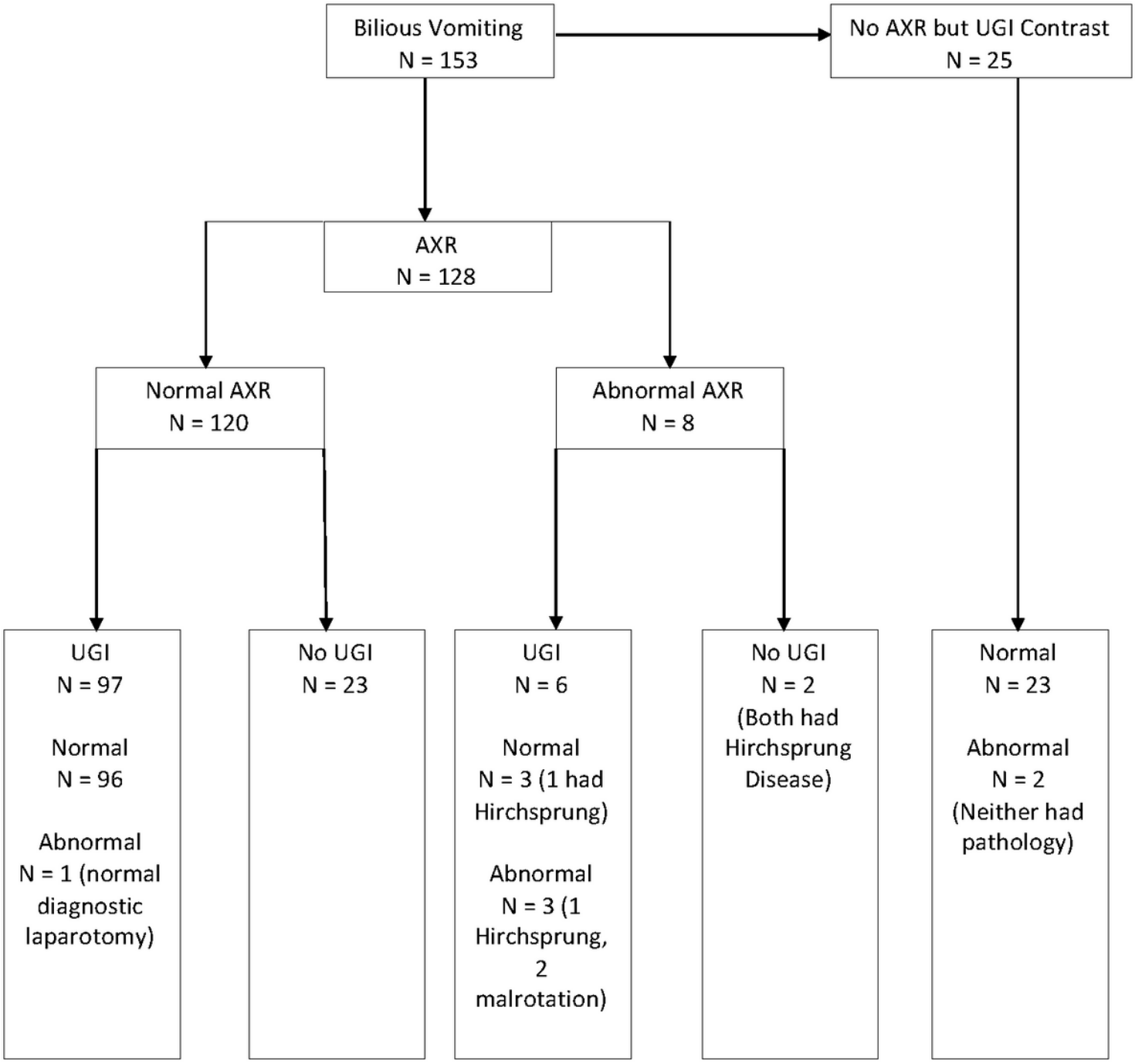

Figure 1

Radiological investigations and the outcomes are summarised in Figure 1

Supplementary Files

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- Tables.docx