British Association of Perinatal Medicine

Management of Bilious Vomiting in the Newborn Period and Radiological Support for Neonatal Services

A DRAFT Framework for Practice

August 2023

Contents

Executive Summary

Bilious vomiting is a common symptom in the newborn and can indicate pathology. In particular, there are concerns that there could be malrotation / volvulus which can present with no other symptoms. A surgical diagnosis occurs in about 25% of term babies with bilious vomiting but only about 8% have malrotation. Many babies are transferred for urgent contrast studies to exclude the possibility of malrotation.

In term babies with bilious vomiting assess carefully, consider other diagnoses and treat for infection. Consider the possibility of surgical problems and discuss cases with a surgeon and a neonatologist. A care pathway for these babies is suggested which can be used to inform local guidelines. A separate pathway is suggested for preterm babies.

Some minimum standards for radiology cover for NICUs / LNUs and SCUs are suggested.

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Introduction and Background

The national neonatal GIRFT report (2021) [1] identified problems with radiological support to neonatal units. This ranged from some units not having on site capacity to do plain radiographs 24 / 7 but was most notable in the management of babies who need upper gastrointestinal (GI) contrast studies for bilious vomiting. The findings from the report prompted the development of this framework as there were no published standards for radiological support for neonatal units and the development of a pathway for babies with bilious vomiting in the newborn period was recommended to help identify and recommend best practice.

Unfortunately, there are some limitations on the availability of upper GI contrast studies and this has resulted in transfer of many babies to units / hospitals which do have the facility, sometimes over long distances, placing pressure on transport services and capacity in some networks. Various pathways have been developed across different networks to deal with these babies as highlighted in the GIRFT report.

This framework will aim to set some minimum (and optimal) standards for radiological support for neonatal units and define a framework for the management of babies with bile-stained vomiting.

Current situation

In 2021 the neonatal GIRFT review was carried out using data from 2018/2019 available from the neonatal services themselves along with other national data sources. The data were also supplemented with unit visits to each service.

From these data: between April 2018 and March 2019, 721 term infants (37+ weeks gestation) admitted to neonatal units in the first week of life had 974 upper GI contrast studies within 14 days. A quarter of neonatal units (56% NICUs, 20% LNUs and 5% SCUs) did at least one GI contrast study and two hospitals did a quarter of all the studies, with more than 50% of studies done by just six hospitals.

Access to upper GI contrast studies was very patchy with only a third of NICUs having 24/7 access although it was available in some LNUs and SCUs. Surprisingly, even some surgical NICUs did not have a 24-hour service. There was a mix of provision, with some services wholly provided by paediatric radiology, and others where the service was shared with adult radiology colleagues. The 'deep dive' GIRFT visits revealed that the problems with access to radiology and radiography services were not confined to upper GI contrast studies and there were problems accessing portable plain X-rays in some units, with standalone maternity hospitals particularly vulnerable to gaps in service/ no on-site services after hours.

These data, together with information from deep dive visits, suggests that large numbers of babies are requiring urgent transfer to another hospital, often late at night, for an upper GI contrast study and surgical review, followed by a subsequent journey back to their local hospital in many cases. At a conservative estimate, this is likely to affect in excess of 500-600 babies a year which is consistent with numbers from a previous UK-wide audit of transfers for bilious vomiting [1]. This places a significant burden on neonatal transport services, reducing availability of the service for other sick neonates, and often results in unnecessary mother and baby separation. In some regions, transport services do not have the capacity to support transfer of these babies and local hospitals are required to undertake the transfer themselves, resulting in variable quality of transport service provision, significant delays in time taken to perform contrast study, as well as pressure on both the local ambulance service and local hospital teams. This also results in a potentially unnecessary admission

to surgical NICUs.

There is currently a very inequitable service, with some neonatal units of all designations being able to access contrast studies at least some of the time. Some transport services have a pathway to provide "drive-by" contrast studies, whereby the baby is transported direct to the radiology department in the receiving hospital for the contrast study, where they are also seen and reviewed by the surgical team and, if there is no pathology, the transport team repatriate the baby straight back to the referring unit without admission to the surgical NICU. We have used information from some of these pathways in the development of this framework.

Several other important findings with regard to radiology were revealed from the GIRFT visits:

- Lack of 24/7 upper GI services – only present in a third of NICUs and not present in all neonatal surgical units
- High volumes of transfers some unable to be done by transport services. There are significant problems with delays in transfers due to ambulance service provision in these cases, inexperienced staff undertaking the transfer and families or staff being stranded at the NICU following a normal contrast, with long delays to get repatriated.
- Access to emergency radiography services, particularly at night, can be very slow
- Access for radiography service at night not available on site (for some NICUs – standalone units predominantly)
- Neonatologists reporting all of the X-rays with no official radiology report.
- Adult radiology anxiety around doing and reporting scans generally (not specific to upper GI) and therefore giving many caveats in reports.
- Shortage of paediatric radiology support in many units (national shortage)

Summary of evidence

Bilious vomiting in the newborn in the first few postnatal days has always been regarded as an important clinical sign which could indicate underlying pathology although it can also be seen in babies without pathology. It can be a sign of GI obstruction and importantly can be an indicator of malrotation / volvulus.

Malrotation is a congenital abnormality which results in an abnormal orientation of the bowel and mesentery. It can lead to volvulus (twisting) of the bowel which can result in bowel ischaemia and can be life threatening. Malrotation cannot be diagnosed on a plain abdominal x-ray as it does not show the orientation of the bowel and a contrast study is therefore required. As a result, common practice is that infants with bile-stained vomiting have an upper GI contrast study to exclude malrotation performed. This is usually treated as an urgent investigation.

In recent years, probably following incidents in some centres [2], the fear of missing a diagnosis of malrotation and volvulus has resulted in the idea that ***all*** babies with bile-stained vomiting should have an urgent contrast study to exclude this diagnosis. Because contrast studies are not available at every centre or even every NICU, this has resulted in a large number of transfers of babies for this and a heavy demand on the centres which do provide this service as seen in the GIRFT report. Several studies have looked at the diagnosis of term babies undergoing contrast studies and the frequency of malrotation / volvulus in this group. These studies are summarised in Table 1.

Author	Year	Number of babies	Surgical diagnosis	%	Malrotation	%
Malhotra [3]	2009	61	16	26.2%	6	9.8%
Ojha [4]	2016	165	34	20.6%	10	6.1%
Lee [5]	2020	48	7	14.6%	4	8.3%
Mohinuddin [6]	2014	163	75	46.0%	20	12.3%
Cullis [7]	2018	351	41	11.7%	16	4.6%
Nundeekasen [8]	2021	393	113	28.8%	31	7.9%
Total / Average		1181		24.6%		8.2%

Table 1

As can be seen from the table, only a minority (approximately 8%) have a diagnosis of malrotation / volvulus. Approximately 60% have evidence of infection and 25% have other surgical problems such as lower GI obstruction. If a baby has clear evidence of an alternative explanation for the bile-stained vomiting, then there is not the same need or urgency to exclude malrotation as a diagnosis.

The importance of performing a contrast study is to rule out malrotation and it is only required in the group where this is necessary.

What Facilities / Personnel are Required for a Centre to Carry Out Contrast Studies (See Appendix 1).

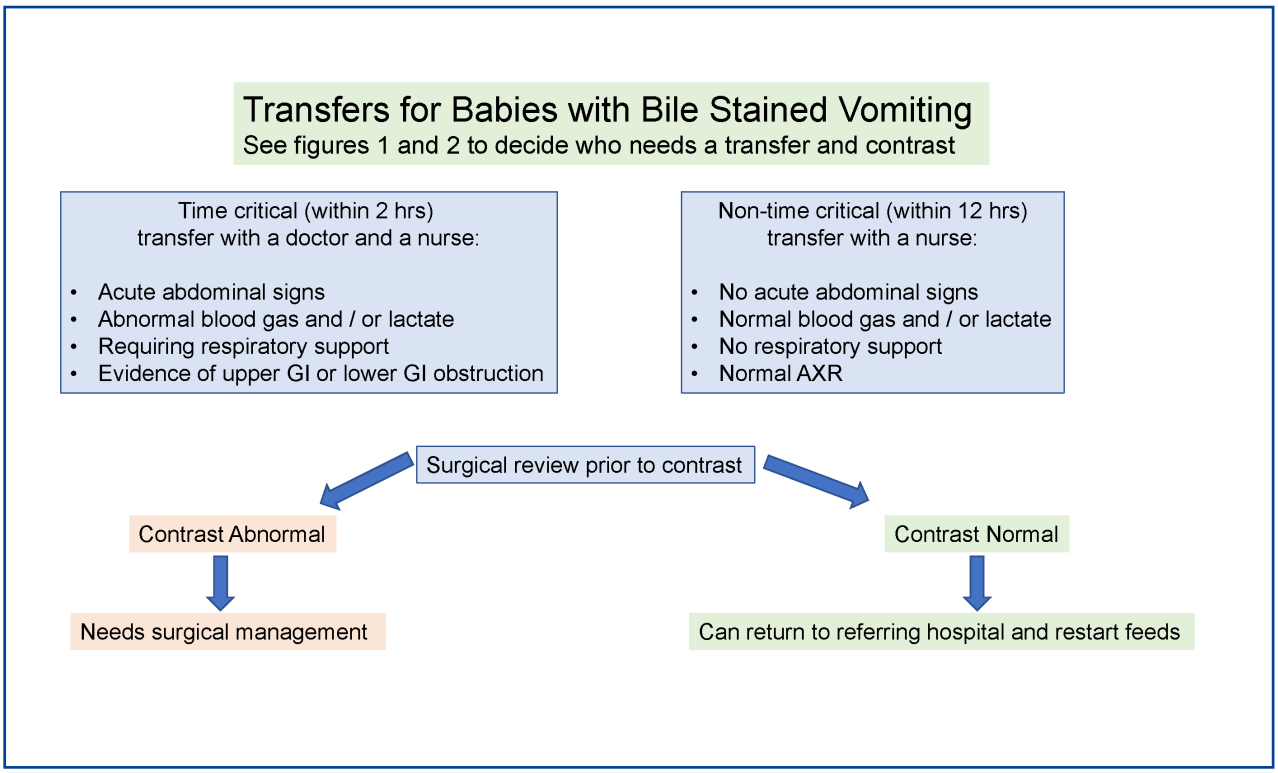
Pathway for Bilious Vomiting and Exclusion / Diagnosis of Malrotation Volvulus

What is bilious vomiting?

Bilious vomiting is when there is a significant (more than just a spot or two on the sheets) quantity of green (usually dark green) ***not*** yellow vomit [9]. The following is also helpful [10]:

True bile-stained vomit that requires immediate attention is DARK GREEN like these.

	Milk
	Lemon
	Lime
	Avocado
	Pea
	Spinach



Preterm Babies (<34^{+0} weeks gestation)

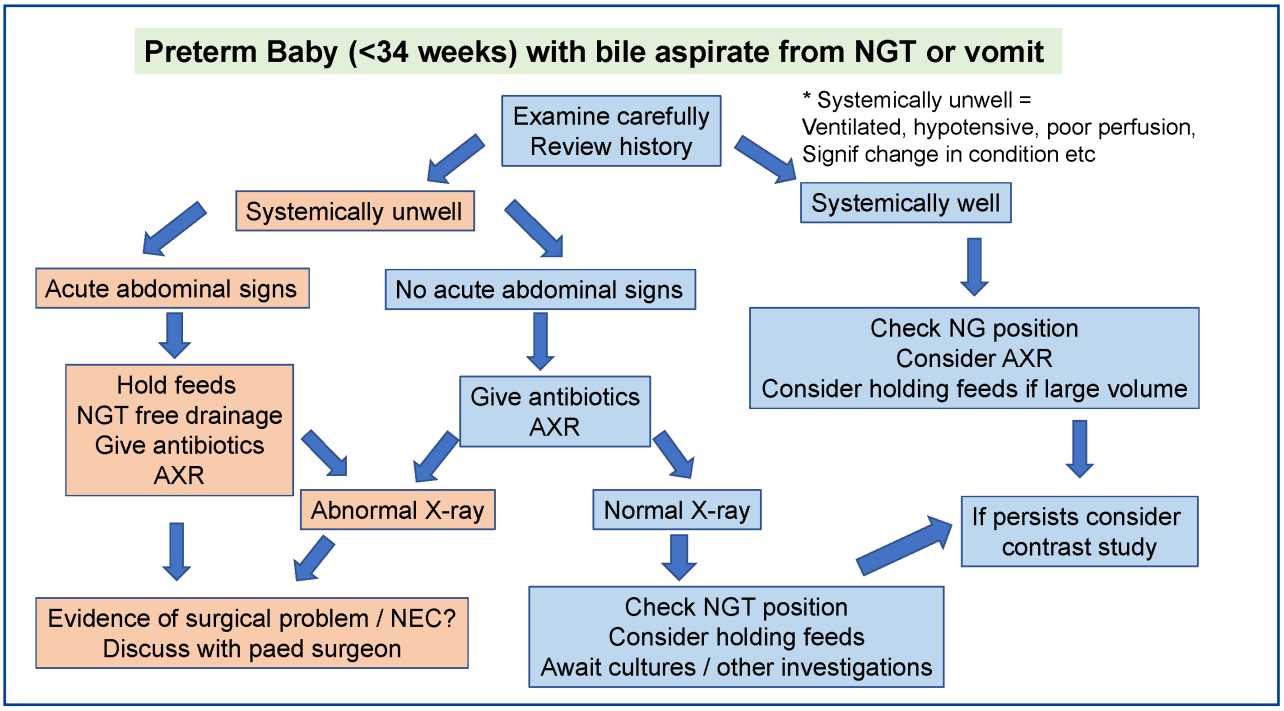


Figure 1: Preterm Baby (<34 weeks) with bile aspirate from NGT or vomit

Preterm babies <34 weeks do not often vomit but will often have an NGT in place and may be found to have green NG aspirates.

The incidence of malrotation / volvulus in preterm babies is likely to be similar to the incidence in term babies. This is estimated at 1 in 500 babies but it is obviously seen more frequently in term babies because of the relative numbers and in preterm babies NEC has to also be considered as a differential diagnosis.

Management

- Examine carefully: Is there a normal anus?
- Was there a delay in passage of meconium?
- Normal antenatal scans?
- Check position of NG tube (if beyond pylorus withdraw to correct position)
- Consider possibility of abdominal problems e.g. NEC – is the abdomen distended, discoloured, tender? Has the baby open bowels? Is the stool normal?
- Are there any other signs of infection? Temperature, respiratory distress, irritability etc
- Is the volume of green vomit / aspirate large? If not replace and continue feeds but observe closely.
- If large volume and or other abdominal signs then consider holding feeds and perform an abdominal x-ray
- If evidence of NEC then continue NBM, commence antibiotics and discuss with surgical team depending on local guidelines.
- If there is evidence of an acute abdomen refer urgently to surgical team using local pathways.
- If NEC has been excluded and bile-stained vomiting persists consider performing an upper GI contrast study to exclude malrotation.

Term (and Near Term) Babies (>=34^{+0} weeks gestation)

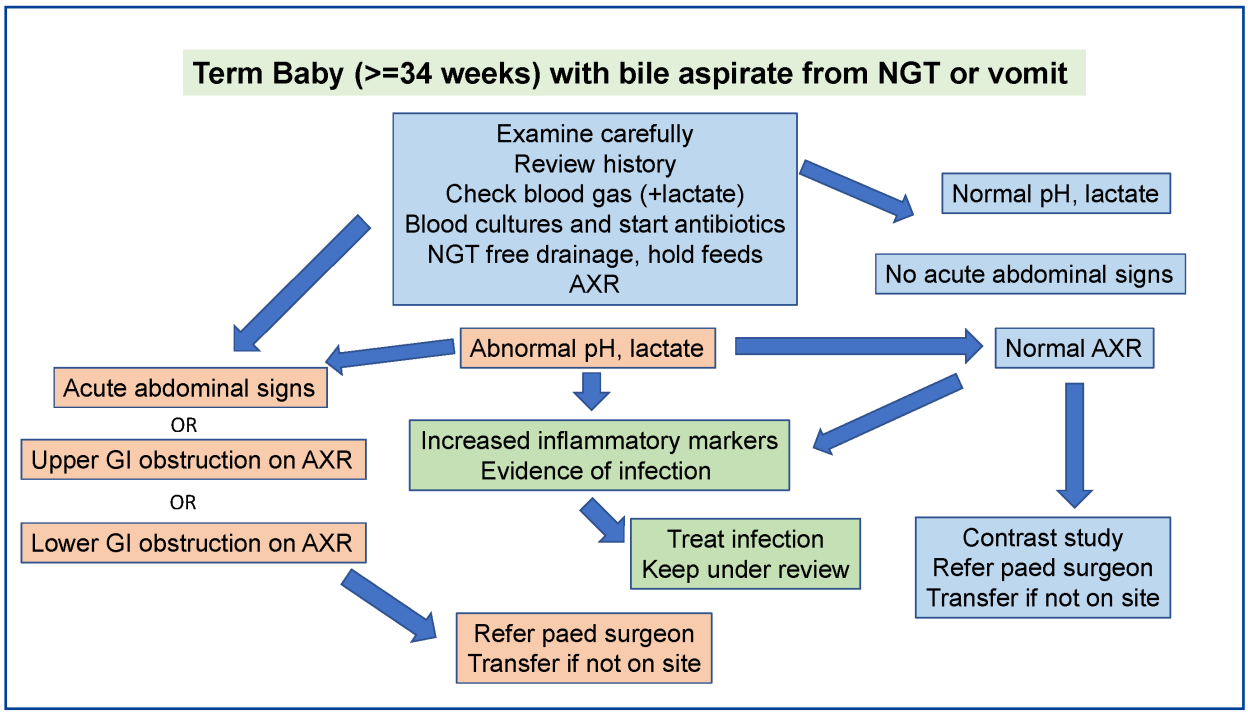


Figure 2: Term Baby (>=34 weeks) with bile aspirate from NGT or vomit

Management

- Examine carefully
- Is there a normal anus?
- Was there a delay in passage of meconium?
- Normal antenatal scans?
- Review pregnancy and birth history: meconium-stained liquor (which may have been swallowed), risk factors for infection (e'g' PROM, maternal infection, chorioamnionitis).
- Insert a large bore nasogastric tube (if not already in place)
- Perform a plain abdominal x-ray (after NGT insertion)
- Check bloods (including blood cultures, blood gas and CRP)
- Commence antibiotics

Following these initial actions there should be an assessment by a senior neonatologist (middle grade or equivalent or consultant) and if a surgical diagnosis is considered likely or if it is considered necessary to exclude a diagnosis of malrotation, a conference call discussion should be held with the referring neonatologist, receiving tertiary neonatologist, transport team and paediatric surgeon:

1. **Babies who require urgent transfer for surgical review**

These are babies where there are abnormal abdominal signs (tenderness, distension) and / or evidence of lactic acidosis. A malrotation / volvulus is possible in babies with these signs and they should be transferred as a time critical transfer. A contrast study may be required but these babies need urgent surgical review and some of the babies in this group may need urgent surgery.

If there is evidence of upper GI obstruction, lower GI obstruction, perforation or NEC on the clinical and plain abdominal x-ray assessment it is likely that a contrast study will not be required but the baby will require surgical care: – a conference call discussion with a tertiary neonatologist and paediatric surgeon is required for transfer to the tertiary surgical NICU.

2. Babies where another diagnosis is likely

In babies with a normal examination and AXR but with evidence of infection (increased CRP, positive blood culture):

- Continue antibiotics and re-evaluate after initial treatment.
- If bilious vomiting persists after treatment for infection discuss via conference call with tertiary neonatologist and paediatric surgeon and consider a contrast study.

3. Babies who require upper GI contrast

Babies with no other diagnostic features (normal x-ray, normal or minimally abnormal examination, no evidence of infection) are the ones who require a diagnostic contrast study to exclude a diagnosis of malrotation. In these circumstances a contrast is required but in the absence of evidence of acute abdominal pathology it does not need to be time critical if the baby is stable and well with no other signs. In some regions it may be possible to carry out a contrast study locally, if appropriate, and in some cases, this may avoid the need for transport.

Any babies where there are abnormal abdominal signs or an abnormal abdominal x-ray should be discussed with a paediatric surgeon as described above.

If there is any evidence of a lactic acidosis or if there is abdominal tenderness then the transfer should be time critical and the contrast study performed urgently and it is likely that transfer to a surgical unit and admission will be required.

Minimum Requirements for Radiological Support for Neonatal Units

Minimum Requirements for Radiological services at a NICU [11]

1. High quality computed or digital radiography for chest, abdominal & extremity radiography, with optimisation of exposure factors to minimise radiation dose. All neonatal X-rays should be performed by a radiographer with appropriate training and experience, and should be reported by a paediatric radiologist. CR & DR systems should utilise manufacturer software optimised for paediatric examinations where available.

2. Portable ultrasound scanners should be available with an appropriate range of transducers for performing cranial and general ultrasound, including Doppler, at the bedside. Operators should have appropriate training and experience for the examination which they are performing. Equipment should have regular maintenance and calibration. Special care should be taken to minimise the risk of ultrasound transducers transmitting infection between infants. Images should be securely archived and stored, preferably on a PACS, and there should be a formal report of every ultrasound examination recorded on the Radiology Information System and in the patient record. This should include examinations performed by non-radiology staff.

3. There should be access to high quality digital fluoroscopy for gastrointestinal contrast studies and other diagnostic procedures. Pulsed fluoroscopy and other dose reducing techniques should be employed whenever possible. Fluoroscopy equipment should be operated by an appropriately trained radiographer and diagnostic procedures performed by a paediatric radiologist.

4. There should be access to CT and MRI facilities for brain imaging. These facilities should be equipped to accommodate ventilated neonates. If these facilities are in a different hospital, systems must be in place to ensure safe transfer of critically ill neonates, who should be accompanied by appropriately trained medical and nursing staff. CT and MRI brain scans should be reported by paediatric radiologists or neuroradiologists with appropriate training and experience in paediatric neuroimaging.

5. There should be a regular multi-disciplinary meeting with neonatologists and radiologists.

Minimum Requirements for Radiological services at an LNU

- An LNU should have at least one radiologist with a sub-specialty interest in paediatric radiology formally recognised in their job plan.
- Radiology services at LNU should aim to have more than one radiologist with a sub-speciality interest in paediatric radiology so that paediatric radiology services could be provided all weekdays between 9am to 5 pm
- There must be Sufficient radiographers to provide imaging services 24/7
- Good quality plain radiography should be available 24/7.
- Continuous Professional Development (CPD) should take place for all imaging staff to maintain their skills in paediatric practice as a separate developmental need from CPD for adult services.
- Equipment should be optimised for neonatal use and specific neonatal imaging software should be employed.
- Radiology services at LNU Trusts should have robust and diagnostic quality links for PACS and Radiology Information System (RIS) with SCU and NICU hospitals so that images can be

shared for second opinions or for continuity of care.

- Radiology services should provide plain radiography, ultrasound services (and computerised tomography scan). Services should be established to provide fluoroscopy studies including specific pathways for contrast enhanced examination of the GI tract.
- Imaging protocols, radiation protection measures and quality assurances should be of a high standard.
- Services should ***consider*** providing fluoroscopy studies during all the weekdays between 9am to 5pm.
- All neonatal X-rays should be reported by radiologist within the next working day.
- There should be clearly defined escalation pathways for emergency and specialist referral
- There should be a weekly multi-disciplinary meeting with paediatrician/neonatologist and radiologist.
- Neonatal network services ensure access to imaging modalities including fluoroscopy studies at LNU where it is not available locally

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