PAEDIATRIC GASTROINTESTINAL RADIOLOGY

Objective	Guide to Radiology of the Paediatric Intestinal Tract
Responsibility	Radiologist/ Registrar
Frequency	As required

Associated Documents :
RADFLPAEPR003 Contrast mixes
RADFLPAEPR001 Paediatric Barium swallow / Meal
RADNRFLUPR512 Barium / contrast swallow, meal, ft SS
RADFLPAEPR012 Paediatric Barium / Contrast enema
RADNRFLUPR514 Barium/ contrast enema SS

INTRODUCTION

This is intended as a basic guide to the radiology of the intestinal tract in children. As we have stated in the past, children are not little adults; they have different diseases, different therapy and therefore require a different radiographic approach. Studies in children need to be directed, performed as quickly as possible to gain the information needed with the least amount of administered radiation. Good clinical information is mandatory to perform the correct study, if this is not clear from the request form, call the referring team to clarify. Parents often provide extra information and are usually very knowledgeable about past problems and procedures. Take time to talk to parents and tell them about the procedure and answer questions. Upset parents convey their feelings to their children and everyone benefits when they are relaxed.

As with other modalities, use your eyes and hands to examine the patient before beginning the procedure (we may be radiologists but we are still doctors!). Always look at any previous studies before starting the procedure, someone else has done a lot of work so use it to your advantage.

An upper GI series is a contrast swallow plus the GI tract below the diaphragm to the ligament of Treitz. Think of any upper GI series as the two examinations and you won't miss anything. A meal and follow-through also includes spot films of the terminal ileum with intermittent radiographs (generally at 30 minute intervals) of the small bowel until the terminal ileum is reached. Studies are generally tailored to the clinical question and the patient. When performing a barium enema, contrast is followed until it is refluxed into the terminal ileum and/or appendix. Single contrast enemas are generally performed in children.

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Specific Age Groups

1. INFANTS

   Do not leave them unattended on the table. Keep one hand on them at all times. Keep them warm, babies have poor thermostats. For premature and term neonates, the room is generally warmed prior to their arrival, but always try to keep them covered as well. For upper GI studies, the baby has usually been starved and often will readily drink from a bottle or teat. For some studies, a feeding tube will be inserted to get an adequate study. Remember to cone for less exposure and better pictures. Keep the screen close to the patient for less exposure. Keep the screening time to a minimum.

2. SMALL CHILDREN (2-4y)

   This is often the toughest age group. They tend to be really good or really bad! Be firm, keep control of the situation and be expeditious. This age group can sometimes benefit from play therapy. Calm explanations of the x-ray “camera”, the TV that looks inside the tummy can be very effective. Explain that the machine makes some funny noises and the table can “move like a spaceship” helps so the child won't be startled by sudden noises/movements. Talking to the child during the study, praising them as you go helps.

3. CHILDREN (5-12y)

   This group is usually eager to please. These children need simple explanations and in general are cooperative. Again, a firm gentle approach with lots of praise gets the most cooperation.

4. ADOLESCENTS

   This is a mixed group. Some are poised and sure of themselves, others (often those very sick and/or with chronic disease) are passive and fed up. Explain the study clearly and briefly and perform the procedure in a timely fashion. Although rarely encountered, always consider the possibility of pregnancy in an adolescent female before performing the study.

CONTRAST AGENTS

ENEMA

Agents:

1. Omnipaque 300 (can be administered full, half or one third strength depending on the age/size of the patient- premature neonates should be given dilute contrast).
2. Gastrografin (half strength, diluted with water)
3. Barium

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If concerned about the possibility of perforation during the procedure, non ionic contrast should be used. Gastrografin can be used to help reduce a meconium plug, meconium ileus or meconium ileus equivalent in cystic fibrosis.

BARIUM SWALLOW AND UPPER GI SERIES

Agents:

1. Barium- liquid and paste
2. Omnipaque 300

Non ionic contrast should be used if there is concern about perforation.

DO NOT use ionic contrast agents such as Gastrografin for upper GI/swallow examinations due to the risk of chemical pneumonitis if aspirated during the procedure.

OESOPHAGEAL ATRESIA AND TRACHEO-OESOPHAGEAL FISTULAS

The baby with oesophageal atresia presents immediately after birth. The classic history is of the baby choking when it is first fed. Because the passage of secretions is obstructed, they are often aspirated. Additionally, reflux of gastric contents into the trachea from a distal tracheo-oesophageal fistula may cause additional pulmonary problems.

The first studies you should look at are the AP and lateral views of the chest and the AP view of the abdomen, making sure the neck and thoracic inlet are well seen. Often the proximal pouch of the oesophagus is filled with air or secretions and readily seen as a “mass” posterior to the trachea, bowing the trachea slightly forward. If there is a connection between the distal trachea and oesophagus, the GI tract will be filled with air. If not, the abdomen will be gasless. Fifty percent of those with OA and TOF will have other significant abnormalities involving the heart, GI tract and bony skeleton, so other clues may be evident on plain films.

What will you be looking for in a barium study of the proximal oesophagus in such patients?

1. Length of pouch

2. Evidence that this is atresia and not a stenosis or web

3. A proximal fistula to the trachea (rare)

4. The position of the aortic arch

Have suction available. A small diameter end-hole catheter should be introduced through the nose into the proximal oesophagus. NO catheter manipulation should be done without fluoroscopic control. The catheter will usually curl up in the oesophageal pouch. Take care that the catheter does not exert pressure on the pouch. An AP and lateral view can be taken with the pouch distended with air, and this is often the only contrast that is necessary.

The only reasons to use barium are:

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1. If the views with air are inadequate; or

2. If there is serious question of proximal fistula.

Have a small syringe ready and filled with a maximum of 2cc of dilute barium/water mix. This precaution will prevent flooding, if, in the excitement of the moment, the syringe is plunged too forcefully. If the baby cannot be fluoroscoped upright in a special immobilising unit, views of the oesophageal pouch outlined with barium should be taken in the lateral and AP projections with the baby's head and neck supported by towels or sponges or with the head of table elevated. After these views are obtained, the barium is aspirated through the catheter. Make sure that the barium is not in a false channel in the retropharynx. A false channel is more posterior in location, does not have an effect on the trachea, is narrower and more irregular and does not empty itself well of residual barium.

Babies with H-type fistula may not present in the immediate neonatal period, but come to medical attention with recurrent pneumonias and/or chronic GI distension with air. They frequently have a history of respiratory distress with feeding. The contrast examination should be done after plain films of the chest are evaluated. Areas of pneumonia are commonly seen in the lungs. Because of the fistulous connection between the trachea and oesophagus, the GI tract is often more distended with gas than usual. A soft end-hole catheter should be passed into the mid oesophagus. The baby should be in a prone oblique or true lateral position to facilitate filling of the fistulous tract and to visualise the trachea and oesophagus as two distinct structures. Dilute barium and water mixturein a 10cc syringe should be injected through the tube at progressively higher levels in the oesophagus.

You should look for:

1. Fistula

2. Barium in the trachea

Barium should be kept below the level of the pharynx so that aspiration does not occur. The purpose of using the catheter is to be able to inject barium with more pressure than the normal swallow would generate and to control the examination. Good distension of the oesophagus can be achieved by injecting a bolus of air into the barium coated oesophagus. If no fistula is identified, then have the baby drink the barium-water mix via a nipple and look for aspiration, laryngo-oesophageal cleft and a fistula you might have missed.

VOMITING IN THE NEWBORN

What are the major diagnostic possibilities for newborns who present with vomiting? From the oesophagus down they are:

1. Oesophageal web (rare)

2. Chalasia/hiatus hernia

3. Antral web

4. Pyloric stenosis

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5. Duodenal atresia/stenosis

6. Jejunal atresia/stenosis

7. Malrotation with volvulus

Obstructive lesions in the lower GI tract, e.g. meconium ileus, leal atresia, or Hirschprung's disease may have vomiting as a later sign.

Make sure the vomiting is a real sign (most babies “spit up” from time to time). It helps to know if bile is present in the vomitus. Bilious vomiting is most often a surgical (as opposed to medical) problem.

How do you start? After obtaining all the pertinent information and looking at the plain films which we shall assume are non diagnostic (e.g. no 'double bubble' or duodenal obnstruction), position the baby supine on the fluoroscopy table. Quickly look at both hemidiaphragms to assess mobility, scan the lungs looking for air trapping, areas of pneumonia etc. Look at the mediastinum to make sure the thymus contracts normally on deep inspiration and look at the babies larynx and subglottic region of the trachea. This is best done with the babies head extended- put a small towel under its shoulders.

Then turn the baby on to its left side with arms above and slightly behind its head. Having the baby on the left will pool the barium in the fundus until such time as you want to study the antrum of the stomach and duodenum. Hold the babies pelvis with your gloved right hand (or put the glove under the baby and hold the pelvis with your bare hand). The baby then swallows contrast while you assess the swallowing function of the pharynx. Is there nasopharyngeal reflux? Does the baby aspirate barium into the trachea? Is the swallowing normal or poorly synchronised? Follow the oesophagus looking for abnormal impressions from vessels/masses. Turn the baby LPO to the table and look at the contour of the oesophagus all the way down. Then, do the same thing AP. A good routine for spot films is a lateral of the upper oesophagus and nasopharynx, a lateral of the entire oesophagus, and AP view of the full oesophagus. LPO and RPO views can be taken if there is any abnormality found. It is a good idea to get your spot views early. Small babies may tire quickly and not drink the large boluses required for a good study. After the views have been taken, have a good look at the cardio-oesophageal junction for any hints of hiatus hernia.

HINT: Hold the bottle so the baby swallows half barium, half air. This provides a gas filled 'window” through the antrum when the baby is turned supine.

PYLORIC STENOSIS

Most babies are now diagnosed with ultrasound, however, keep in mind the possibility of diagnosing pyloric stenosis on an upper GI study.

The main plain film findings of pyloric stenosis are a distended stomach, indentation of the stomach wall by peristalsis, and decreased air throughout the distal bowel. If the stomach is full of fluid on the plain films, find out when the baby was fed last. Gastric empyting should have occurred within four hours after feeding. When the baby has a full stomach, it is best to empty it by nasogastric tube before giving barium. The signs of pyloric stenosis on upper GI series are as follows:

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1. Marked peristaltic activity of the stomach (early in disease), gastric dilatation and atony (late in disease).

2. Elongation of the pyloric channel with “railroad tracks”.

3. Eccentric curve of the pylorus.

4. Shoulder sign of the pyloric tumour abutting the lesser curve of the stomach.

5. “Tit” sign of the lesser curve (the peristaltic wave hitting the muscle mass).

6. Concavity in the base of the duodenal bulb.

Over-distension of the stomach with barium will cause overlap of the gastric antrum by the fundus of the stomach and obscure the pylorus. Because barium often takes a long time to pass in to the duodenum in patients with pyloric stenosis, try to fluoroscope intermittently. Document the abnormality by getting at least two spot images in lateral and steep oblique positions. Then aspirate barium out of the stomach via the NG tube.

Upper GI studies are performed using the same technique in most babies. After assessing the oesophagus and with the stomach full, roll the baby towards you in the prone position and RAO to the table. The babies will usually continue drinking in this position giving you another look at the oesophagus. This is the best position for viewing the gastro-oesophageal junction. The more barium that goes in the stomach, the more will go out the duodenum as long as no obstruction is present. Look at the antrum for an antral web- a fine, linear filling defect arising from the stomach wall. If all looks normal to this point then the pylorus should be studied well to exclude hypertrophic pyloric stenosis (particularly in the 6week to 3 month old babies, usually male 4:1). Take a spot view of the antrum, pylorus and bulb in the oblique position. Then follow the duodenum to the DJ flexure (ligament of Treitz) with the first bolus of barium that passes through, and document its position. This has to be done right away because in the newborn, jejunal loops will quickly obscure this landmark. Take the bottle away and turn the baby supine. This position is also needed to evaluate the duodenal-jejunal junction which should be to the left of the spine, in the transpyloric plane.

Transient, minimal reflux of barium is normal in the newborn. Reflux that distends the oesophagus as much as when the baby swallowed the barium is abnormal. Two points have to be made here. If you document significant reflux, make sure the baby does not have hiatus hernia of adults as it is associated with more morbidity- oesophagitis and failure to thrive. Also, make sure there is not gastric outlet obstruction with reflux being a secondary phenomenon.

Always look at the views you have taken before letting the baby leave the department. Cineloops can help in this regard. If you are uncertain about an area after looking at everything, take the baby back and re-examine the area. A good, complete examination should be done the first time around.

ABDOMINAL DISTENSION IN NEONATES AND/OR NO PASSAGE OF MECONIUM

Babies should pass meconium within 48 hours of being born. The causes for abdominal distension and failure of passage of meconium and stool are summarised under one heading: Obstruction. The obstruction may be mechanical, e.g. atresia, or functional, e.g. aganglionosis (Hirschprung's

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disease). How do you start evaluating these infants? History and physical examination plus available plain radiographs. Are there siblings with cystic fibrosis to implicate meconium ileus? Does the child have a known syndrome or other anomalies? Are you sure the anus is patent? Is the baby very sick to suggest midgut volvulus complicating malrotation?

Plain films should include AP, upright and, if necessary for more information, prone film of the abdomen. If there are multiple loops of bowel filled with gas and fluid and no free air, a contrast enema should be done.

What are the possibilities for obstruction and what do they mean?

1. **Meconium plug**- self limited 'disease' with meconium in the colon which the baby cannot pass on it's own. Often associated with small left colon. Seen in premature or dehydrated infants and infants of diabetic mothers. Commonest and least serious obstructing problem. The enema is usually curative. Close follow up of these children is needed to make sure they do not have Hirschprung's disease.
2. **Meconium ileus (uncomplicated)**- Seen in patients with cystic fibrosis, 10% present with this problem. The meconium is stickier and more tenacious than normal and clogs the ileum. Not related to meconium syndrome.
3. **Meconium ileus (complicated)**-Meconium plugged ileum may perforate into the peritoneum. There may be atresia or volvulus of the small bowel associated with the perforation. Obstruction tends to be more proximal than uncomplicated meconium ileus. Calcification in bowel wall and/or peritoneum is a helpful sign of meconium peritonitis. (Calcification resorbs over time so that an abdominal examination, later, may not show it).
4. **Malrotation with volvulus**- usually meconium has been passed. Stool may be bloody. Baby usually has bile stained vomitus and attention is directed to the upper GI tract. The mesenteric attachment to the posterior abdominal wall is narrow predisposing to volvulus and Ladd bands cross the duodenum adding further to the obstruction. Normal colonic position does not rule out malrotation. High caecum may be an incidental finding, unassociated with malrotation.
5. **Ileal atresia**-?Vascular accident to the ileum in foetal life resulting in atresia. Unused colon (microcolon) if insult was early in intrauterine life.
6. **Aganglionosis**- Ganglion cells absent from a variable length of distal colon. 80% have a transition zone of rectosigmoid. Rarely total aganglionosis of colon.

The first enema any constipated child should have is a contrast enema.

Make sure you have a 24 hour post B.E. Image on a neonate with the question of Hirschprung's disease. Normal babies evacuate the barium within 24 hours; the baby with Hirschprung's disease typically has delayed evacuation and the transition zone is more apparent.