CAR Standard for Performance of Pediatric Contrast Enema Examinations

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The standards of the Canadian Association of Radiologists (CAR) are not rules, but are guidelines that attempt to define principles of practice that should generally produce radiological care. The physician and medical high-quality physicist may modify an existing standard as determined by the individual patient and available resources. Adherence to CAR standards will not assure a successful outcome in every situation. The standards should not be deemed inclusive of all proper methods of care or exclusive of other methods of care reasonably directed to obtaining the same results. The standards are not intended to establish a legal standard of care or conduct, and deviation from a standard does not, in and of itself, indicate or imply that such medical practice is below an acceptable level of care. The ultimate judgment regarding the propriety of any specific procedure or course of conduct must be made by the physician and medical physicist in light of all circumstances presented by the individual situation.

I. INTRODUCTION

Examination of the colon in children by contrast enema is a proven and useful technique for evaluation of the large bowel. The goals of this standard are to state the performance and indications for contrast enema examinations in children ages 0 to 18. This standard was developed to guide physicians in the performance of contrast enema examinations for evaluating the colon in pediatric patients.

II. INDICATIONS

The contrast enema is used to diagnose diseases that intrinsically and extrinsically affect the colon. Indications for contrast enema examinations in pediatric patients generally include, but are not limited to, evaluation for inflammatory disease of the bowel, lower GI bleeding, malrotation, postoperative conditions of the colon, lower intestinal obstruction, evaluation of familial diseases involving the colon, and other disease states, that intrinsically and extrinsically affect the colon. Specific pediatric indications for contrast enema include diagnosis and treatment of intussusception, meconium ileus and diagnosis of Hirschsprung disease.

All imaging facilities should have policies and procedures that comply with provincial regulations concerning the identification of pregnant pediatric patients prior to the performance of any diagnostic examinations involving ionizing radiation, which includes any contrast enema examination. If the patient is known to be pregnant, the potential radiation risk to the fetus and clinical benefits of the procedure should be considered before proceeding with the study. Contraindications to contrast enema evaluations include evidence of perforation of the colon or a toxic megacolon. The choice of contrast material varies according to clinical setting and the training of the physician, and the choice is at the discretion of the performing diagnostic radiologist.

III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

A. Physician

That Physicians involved in the performance, supervision and interpretation of pediatric enema procedures should be Diagnostic Radiologists and must have a Fellowship or Certification in Diagnostic Radiology with the Royal College of Physicians and Surgeons of Canada and/or the Collège des médecins du Québec. Also acceptable are foreign Specialist qualifications if the Radiologist so qualified holds an appointment in Radiology with a Canadian University.

As new imaging modalities and interventional techniques are developed additional clinical training, under supervision and with proper documentation, should be obtained before radiologists interpret or perform such examinations or procedures independently. Such additional training must meet with pertinent provincial/regional regulations. Continuing professional development must meet with the requirements of the Maintenance of Certification Program of the Royal College of Physicians and Surgeons of Canada.
B. Radiological technologist

1. The medical radiation technologist must have the Canadian Association of Medical Radiation Technologists (CAMRT) certification or be certified by an equivalent licensing body recognized by the CAMRT.

2. Under the general supervision of the radiologist, the technologist will have the responsibility for patient comfort and safety, for examination preparation and performance, and for image technical evaluation and quality, and applicable quality assurance.

3. The training of technologists engaged in specialty activities shall meet with applicable and valid national and provincial specialty qualifications.

4. Continued education of technologists is encouraged by the CAMRT and should meet pertinent provincial regulations.

C. Other personnel

1. Rectal catheterization should be performed or monitored by those with experience in pediatric rectal catheterization. This may be performed by radiologic technologists, nurses, physicians’ assistants or physicians.

2. When performing the catheterization or examination of an adolescent girl, it is advisable to have an adult woman present in the room as a chaperone or as the person performing the examination or the procedure.

IV. SPECIFICATIONS OF THE EXAMINATION

A. Conventional diagnostic barium enema

The following examination descriptions may be modified by the physician to produce examinations of equal or better quality. The physician should modify any or all parts of the examination as warranted by clinical circumstances and the condition of the patient. Barium is used unless there is concern for potential perforation of meconium ileus, in which case water-soluble contrast is used.

Single-contrast examination is used unless there are specific indications for double-contrast study, such as hematochezia, occult blood in the stool, or clinical concern for inflammatory diseases or polyps.

The child should be prepared for the procedure with an explanation appropriate to the developmental stage. Physical restraint or immobilization of the infant or young child may be helpful to minimize radiation exposure to the child and the personnel, and to stabilize the child’s position during the procedure. Appropriate gonadal shielding and filtration should be used when possible. A preliminary film may be obtained if indicated.

1. Single contrast barium examinations

   a. Examination preparation

   Preparation for single contrast study is limited to restriction of oral intake prior to the study for an appropriate length of time according to the patient's age unless the examination is performed on an emergency basis. A child under six should be NPO for three hours prior to the study. A child over six should NPO after midnight for a study in the morning and NPO after a clear liquid breakfast for a study done later in the day.

   b. Examination technique

   i. Unless the study otherwise indicates, the smallest possible catheter permitting adequate contrast flow is used. No balloon or cuff should be inflated unless there are indications to do so.
ii. Rectal administration of a sufficient volume of low-density (15-20% weight/volume) barium is used to provide colonic distention.

This is typically instilled beginning with the patient in the left lateral decubitus position. The patient is then turned to visualize the flexures and entire colon.

iii. Kilovoltage of 100 kVp or greater should be used for filming.

iv. Spot films should be obtained of any abnormality noted during fluoroscopy.

v. Overhead films should include a frontal view and (if indicated) a lateral view. The rectum should be included in its entirety on any lateral film.

vi. A post-evacuation film and delayed post-evacuation films can be obtained if necessary.

2. Double contrast examination

a. Colon preparation
Colon preparation is important to obtain an adequate examination. However, it should not be used in patients with suspected active colitis or active bleeding. The preparation should consist of any effective combination of dietary restriction, hydration, laxatives (in a dose appropriate for body weight) and cleansing enemas. If there is concern for water intoxication, saline should be used.

b. Examination technique

i. High-density (100% weight/volume) barium suspension should be used for this examination.

ii. Kilovoltage of 100 kVp or greater should be used for filming.

iii. Barium should be instilled per rectum under fluoroscopic guidance.

iv. Air is then instilled slowly and the patient should be rotated as needed to coat the mucosa well with barium.

v. Fluoroscopic spot films may be obtained immediately or after the overhead films have been taken to further evaluate any lesion demonstrated.

vi. Overhead films should include frontal supine, frontal prone, and both decubitus views. Supplemental views should be obtained when needed.

c. Intussusception

i. Examination preparation
No preparation is necessary. The patient should be NPO once the possibility of intussusception is seriously entertained as surgery may be necessary to reduce an intussusception that cannot be reduced by contrast enema.

ii. Examination preliminaries
If concerns of perforation or peritonitis exist based on clinical and/or radiographic findings, a surgical consultation should be considered. Preliminary radiographs of the abdomen should be obtained to diagnose an intussusception and to identify free peritoneal air, which would be a contraindication to contrast enema. The study should not be performed if there is clinical evidence for peritonitis. The patient should be rehydrated prior to the enema if there is evidence of significant dehydration. As large a catheter as the patient can reasonably tolerate should be used.

If an air enema for pneumatic reduction of an intussusception is performed, the equipment used should include a manometer to measure insufflation pressure and a
filtration system to protect any reusable portions of the equipment. An 18-gauge needle should be available for paracentesis if a tension pneumoperitoneum develops during a pneumatic reduction technique.

iii. Examination technique

A) Hydrostatic liquid reduction

1) Barium or dilute water-soluble contrast media may be employed for fluoroscopically controlled diagnostic and therapeutic enema for intussusception.

2) The patient’s rectum should be catheterized with a soft catheter, and the catheter should be securely taped to the patient’s buttocks. The buttocks should be firmly taped to provide as tight a seal as possible. A balloon can be blown up in the rectum as needed to maintain a closed system during reduction of an intussusception.

3) The examination can be performed in the supine or prone position. The patient can be repositioned during the enema to better visualize the intussusception.

4) The colon should be filled by gravity infusion with the fluid in the enema bag no more than three feet higher than the fluoroscopy table. Spot radiographs should be kept to a minimum to limit the radiation dose.

If an intussusception is encountered and reduction is incomplete, the hydrostatic pressure should be continued. At any time, if the intussusception is reduced, contrast should be allowed to generously fill the distal small bowel. The radiologist should then search for a residual-filling defect in the contrast column to suggest a pathologic lead point or failure of reduction of the intussusception. The contrast should then be drained. A continuous hydrostatic reduction or a filling/refilling technique can be used.

5) A radiograph of the abdomen should be performed at the completion of filling and after evacuation or gravity drainage of the colon; this may identify spontaneous reduction of a previously irreducible intussusception or re-intussusception of a previously reduced intussusception. Fluoroscopy can be utilized to further document complete reduction of the intussusception.

B) Pneumatic reduction

1) Air, CO₂ and O₂ may be employed for fluoroscopically controlled diagnostic and therapeutic enema for intussusception.

2) See A) 2) above.

3) See A) 3) above.

4) The pressure must be monitored as the gaseous contrast is insufflated into the colon. The pressure should initially be maintained at or below 80 mm Hg at rest.

The number of spot radiographs should be kept to a minimum to limit the radiation dose. Intermittent fluoroscopy should be performed to identify an intussusception, normal filling of the colon and small bowel, or a pneumoperitoneum. Should an
Intussusception may be encountered, the pressure may be increased to 120 mm Hg at rest as needed to facilitate reduction (the pressure may fluctuate and be higher when the patient is crying, straining or performing a Valsalva manoeuver, but it should not exceed 120 mm Hg at rest).

The length of time spent on a continuous reduction attempt or intermittent filling is at the discretion of the individual radiologist. If the intussusception is reduced, air should be allowed to generously fill the distal small bowel. The radiologist should search for a residual-filling defect to suggest a lead point or incomplete reduction of the intussusception. If a tension pneumoperitoneum occurs, paracentesis should be performed immediately.

5) A radiograph of the abdomen should be performed at the completion of air sufflation. This may identify spontaneous reduction of a previously irreducible intussusception or re-intussusception of a previously reduced intussusception. Documentation of the absence of pneumoperitoneum as a complication of the procedure is also accomplished by this radiograph.

C) Hirschsprung disease

1) Examination preparation

The patient less than or equal to six years of age should have oral intake limited for three hours prior to the exam. Patients greater than six years of age should have oral intake limited after midnight.

The patient should have no bowel preparation prior to the enema, including no oral or rectal cleansing medications, and preferably no digital examination performed recently.

The examination should not be performed within the first 24 hours after a suction rectal biopsy or within four days of a full thickness rectal biopsy.

2) Examination preliminaries

Preliminary radiographs of the abdomen can be helpful in analyzing the preparation status of the patient, the extent of the exam to be accomplished, and the presence of obstruction, and abnormalities of the spine.

3) Examination technique

- Barium is the routine contrast media employed for the evaluation of childhood Hirschsprung disease. In the neonate, dilute water-soluble contrast material can be utilized.

- The patient's rectum should be catheterized with a soft catheter, with the tip just inside the rectum. The caliber of the catheter should be small for the patient's size in order to avoid effacing a transition zone. No balloons should be blown up in the rectum during the course of the examination.

- The examination should begin in the left lateral decubitus position, with fluoroscopy and lateral and frontal views obtained of the rectosigmoid colon to evaluate for a transition zone and irregular contractions of the aganglionic colon.

- The patient should have the colon filled gently with contrast material. The intent of the examination is to fill the colon to the level of a transition zone. If malrotation is of concern, the
remainder of the colon can be filled for documentation of colonic position. However, the possibility of barium impaction or adverse effects of water soluble contrast retained above the transition should be kept in mind when filling the entire colon with contrast material in a patient for the evaluation of childhood Hirschsprung disease, if the colon is markedly enlarged.

- Frontal views of the abdomen should be obtained following colonic filling. The catheter should be removed, and then post-evacuation views in the frontal and lateral projections are suggested to allow for evaluation of a transition zone. In certain instances, delayed films at 24 and 48 hours can be obtained for evaluation of colonic emptying.

D) Meconium ileus

1) Examination preparation
Surgical evaluation should precede attempted nonoperative management of simple or uncomplicated meconium ileus. Contraindications to the performance of a therapeutic enema include clinical or radiologic evidence of complicated meconium ileus which includes volvulus, atresia, perforation and pseudocyst formation, and is manifested clinically by a palpable abdominal mass, discoloration of the abdominal wall, and signs of peritonitis, and, radiographically, by intraperitoneal calcifications with or without mass effects, free intraperitoneal air, and ascites.

2) Examination preliminaries
Preliminary radiographs of the abdomen, e.g. supine and left lateral decubitus views, are evaluated for evidence of complicated meconium ileus or other etiologies of neonatal bowel obstruction requiring operative intervention. If the plain films remain compatible with a diagnosis of uncomplicated meconium ileus, a diagnostic contrast enema, usually employing a water-soluble agent, is performed to diagnose simple meconium ileus and exclude other causes of distal intestinal obstruction in the neonate. If the diagnosis of meconium ileus is made by the contrast enema, one then proceeds to the therapeutic contrast enema.

3) Examination technique
- There is currently a wide variety and concentration of water-soluble contrast media used for the therapeutic enema for meconium ileus including half-strength Gastrografin and other ionic and nonionic water-soluble contrasts diluted to similar concentrations. Tween-80 or N-acetylcysteine can be added to the contrast media.

- The rectum is catheterized with a balloon or non-balloon tipped catheter, and the buttocks firmly taped. The catheter balloon is inflated under fluoroscopic guidance when needed.

- Under fluoroscopic control with the infant supine or in left lateral decubitus position, contrast material is gently infused through the microcolon or unused colon into the terminal ileum containing the meconium pellets and into the dilated proximal small-bowel loops.

- There is significant variability among radiologists with respect to the number of attempts, duration of an attempt, and interval between attempts to reflux contrast material into the meconium-filled ileum. In general, repeated attempts at therapeutic enema for meconium elimination and bowel decompression are useful as long as the infant remains well under continued surgical and radiologic evaluation. Immediate post-procedural and every 12-24
hour abdominal films are suggested to evaluate for perforation and degree of meconium evacuation.

- Fluid shifts created by intraluminal hyperosmolar contrast and systemic absorption of hyperosmolar contrast may lead to hypovolemic dehydration and shock. Continued clinical surveillance and correction of fluid and electrolyte status is essential.

V. DOCUMENTATION

The findings of the contrast enema examinations should be reported in accordance with the CAR Standard for Communication - Diagnostic radiology.

VI. EQUIPMENT SPECIFICATIONS

Examinations should be performed with fluoroscopic image intensification and radiographic equipment meeting all applicable federal and provincial radiation standards. Equipment should provide diagnostic fluoroscopic image quality and recording (film, video or digital) capability. Equipment capable of producing kilovoltage greater than 100 kVp should be available. Equipment necessary to compress and isolate regions of the colon for spot filming should be readily available.

Routine monitoring of the equipment should be performed at least annually to assure that there is minimal radiation exposure to the child, the parents and the department personnel. Each imaging facility should have documented policies and procedures for monitoring and evaluating safety and operation of imaging equipment in accordance with local regulations and statutes. A qualified medical radiation physicist should inspect all imaging equipment periodically to be sure that recognized safety standards are met.

VII. QUALITY CONTROL

The following quality controls should be applied to all contrast enema examinations:

When the examinations are completed, the patient should be held in the fluoroscopy area until the images have been checked by the physician.

An attempt should be made to resolve questionable radiologic findings before the patient leaves. Repeat fluoroscopy of the patient should be performed if necessary.

The following is suggested for a quality control program:

- Correlate radiologic, endoscopic, and pathologic findings where available.
- Correlate the radiologic and pathologic diagnosis of Hirschsprung disease.
- Monitor the success and complication rate of contrast enema diagnosis and reduction of intussusception.

VIII. QUALITY IMPROVEMENT

Procedures should be systematically monitored and evaluated as part of the overall quality improvement at the facility. Monitoring should include the evaluation of the accuracy of radiologic interpretations as well as the appropriateness of the examination. Complications and adverse events should be recorded and periodically reviewed in order to identify opportunities to improve patient care. This data should be collected in a manner that complies with statutory and regulatory peer-review procedures in order to protect the confidentiality of the peer-review data.