



Standardization of radiograph readings during bowel management week

A. Bischoff¹ · K. Hayes² · C. Guimaraes³ · A. Merritt¹ · M. Wickham¹ · L. Schneider¹ · H. Martin¹ · J. Ketzer¹ · V. Rodriguez¹ · A. Peña¹ · L. De La Torre¹

Accepted: 3 July 2023 / Published online: 20 July 2023

© The Author(s), under exclusive licence to Springer-Verlag GmbH Germany, part of Springer Nature 2023

Abstract

Introduction During “bowel management week,” abdominal radiographs are used to monitor the amount and location of stool. A radiologist familiar with the treatment plan can provide an improved interpretation. The goal of this paper is to standardize the radiological reports during a bowel management week.

Methods We saw 744 patients during bowel management week from May 2016 until March 2023. Diagnosis included: anorectal malformation (397), idiopathic constipation (180), Hirschsprung disease (89), and spina bifida (78). Laxatives were the treatment for 51% of patients, and 49% received enemas. Characteristic radiographs were selected for each treatment group for a proposed reading standardization.

Results When the stool is visualized, it is crucial to report its location. Having a contrast enema helps with the correct interpretation of the colonic anatomy. It is also essential to always compare the amount of stool with the radiograph from the previous day to determine if there is an increase or decrease in stool. Examples of radiographs are shown to guide the use of the preferred proposed terminology.

Conclusion Providing information regarding which treatment modality the patient is receiving and stating that a patient is on a bowel management week treatment is crucial for the radiologist to provide adequate interpretation. The radiologist must be familiar with the treatment goals and purpose of the daily radiograph.

Keywords Bowel management · Radiographic stool load · Standardized interpretation

Introduction

The term “Bowel Management” is non-specific, as it applies to the management of fecal incontinence [1–3] as well as constipation [4].

It was created with the goal of keeping previously operated Anorectal Malformation patient’s underwear clean of stool, regardless of their bowel control ability. Due to its success, it has also been implemented in patients with

Hirschsprung disease [5], spina bifida [6, 7], spinal cord injury, idiopathic constipation [4], and in some cases of sacrococcygeal teratoma, as well as pelvic traumas.

Daily enemas are used for patients with poor prognosis for bowel control and fecal incontinence, with or without anti-diarrheal agents and diet modifications. The key is to find, by trial and error, the specific enema recipe that cleans the rectum and the left colon over a 1-week period, as demonstrated by daily radiographs. The clinician will make the necessary treatment adjustments based on the amount and location of the stool in the abdominal radiograph performed after the enema and evacuation.

For patients with a good prognosis for bowel control and constipation, daily stimulant laxatives are used, with or without fiber, and diet modifications. Similarly, to the poor prognosis group, the key is to find, by trial and error, over one week period, the specific amount of laxatives that empties the colon as demonstrated by the abdominal radiographs.

✉ A. Bischoff
andrea.bischoff@childrenscolorado.org

¹ Department of Pediatric Surgery, International Center for Colorectal and Urogenital Care, Children’s Hospital Colorado, University of Colorado, Aurora, CO, USA

² Department of Radiology, Children’s Hospital Colorado, Aurora, CO, USA

³ Department of Radiology, University of North Carolina, Chapel Hill, NC, USA

Based on the amount and location of stool, laxatives will be adjusted for the next day.

The first step, before implementation of bowel management, is obtaining a contrast enema with water-soluble material to understand the colon's anatomy and its characteristics (Fig. 1). This study is critical since it will help the radiologist determine the stool's precise location in subsequent abdominal radiographs. An enlarged sigmoid may reach the right upper quadrant or be located in the right lower quadrant, interfering with the visualization of the cecum. Many patients may have had bowel surgery that included bowel resection, especially in cases of Hirschsprung (Fig. 2), and although rare, some patients may also have malrotation (Fig. 3). Another important category of patients are those with a colostomy who would like to know if they are candidates for stoma pull-through [8]. For those patients, the contrast enema and the enema administration are done through the stoma (Fig. 4), and if they have a clean/empty bag for the remaining 23 h of the day, they will be a candidate for stoma pull-through. Understanding the anatomy and characteristic of the colon allows for improved interpretation of the abdominal radiograph during the bowel management week (Fig. 5).

To provide a correct interpretation of the abdominal radiograph, it is also important to know if the abdominal film was taken before or after a treatment enema administration and before or after the patient had a bowel movement.

A radiologist familiar with bowel management should interpret the radiograph. This paper aims to standardize the radiology reports during a bowel management week.

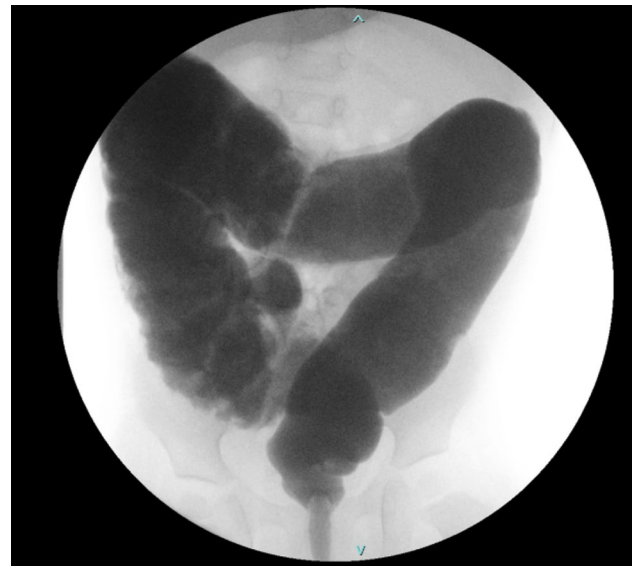


Fig. 2 Contrast enema in a patient operated on for Hirschsprung, showing the lack of the sigmoid curve

Methods

Seven hundred forty four patients were seen during bowel management week from May 2016 until March 2023. Diagnosis included: anorectal malformation (397), idiopathic constipation (180), Hirschsprung disease (89), and spina bifida (78) (Fig. 6). Laxatives were the treatment for 51% of patients and 49% received enemas. Characteristic

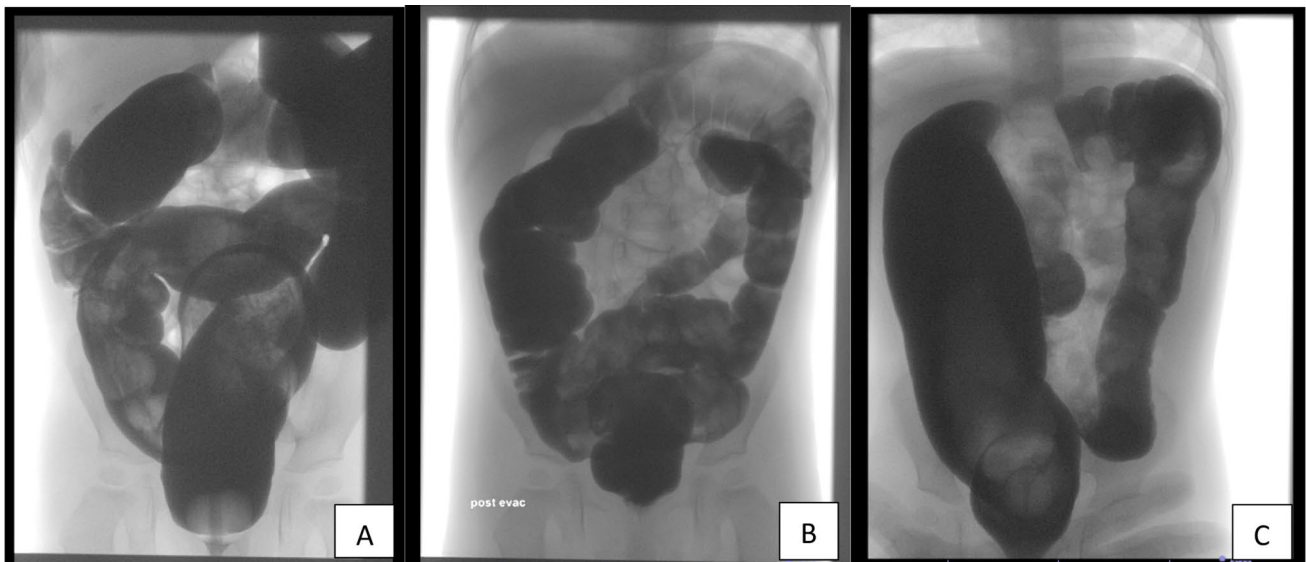


Fig. 1 Contrast enema in a patient with Idiopathic Constipation showing a dilated rectum and redundant sigmoid overlapping the cecum (A and B). Contrast enema showing a massively dilated recto-sigmoid extending to the right upper quadrant in a patient with idiopathic constipation (C)

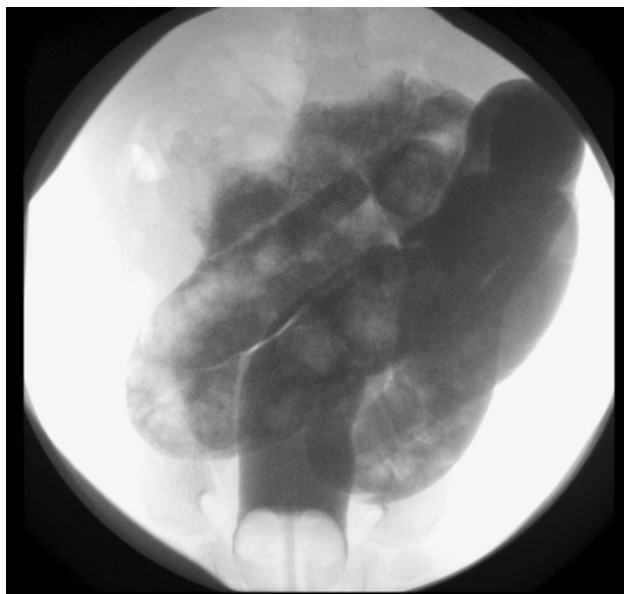


Fig. 3 Contrast enema in a patient s/p Ladd's procedure for malrotation, showing the entire colon in the left side of the abdomen

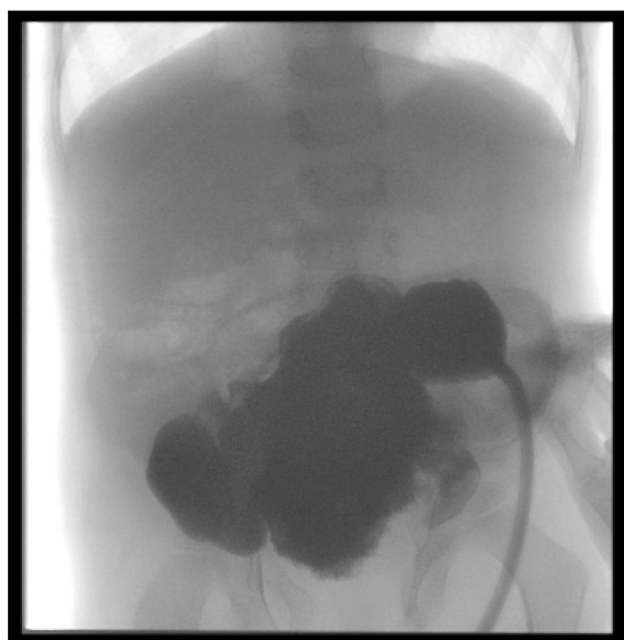


Fig. 4 Contrast enema through the stoma in a patient with cloacal exstrophy showing an abnormal and short colon

radiographs were selected for each treatment group for a proposed reading standardization.

This study was approved by the Colorado Multiple Institutional Review Board (COMIRB #202275).

Results

Having a contrast enema before the bowel management week helped provide the correct interpretation of the stool location.

Radiographs taken after enemas and evacuation should show a clean rectum and colon (Fig. 7), indicating that the enema prescribed effectively cleaned the proposed area. When stool is visualized, it is important to report its location: rectum, left colon, transverse colon, or right colon. Seeing stool in the right colon is acceptable, as it normally takes 24 h for the stool in the right colon to reach the rectum.

If a patient receiving enemas has stool in the rectum and left colon (Fig. 8) in the abdominal radiograph taken after enema administration and evacuation, this is an indication that the enema did not clean the proposed area effectively. In these instances, treatment needs to be modified usually by increasing the concentration of the enema.

During the bowel management week, comparing the amount of stool from the previous day is also very helpful (Fig. 9). The radiograph should never show increased stool compared to the previous day.

It is not infrequent that patients with idiopathic constipation present on the first day of the bowel management week with fecal impaction (Fig. 10), and they need to undergo the disimpaction protocol with enemas before starting laxatives.

For patients receiving laxatives as their treatment, it is also imperative that the amount of stool does not increase from one day to the other. For these patients, however, seeing small amounts of stool in the rectum is acceptable, especially if the abdominal radiograph was taken prior to a bowel movement (Fig. 11). When the abdominal radiograph was taken after a bowel movement and shows stool in the rectum, it means that the patient did not empty the rectum effectively and the laxative dosage must be increased (Figs. 12, 13).

Discussion

Bowel management can dramatically improve the quality of life of patients' suffering from constipation or fecal incontinence.

The most common error that we see when clinicians try to implement bowel management is to not utilize abdominal radiograph to evaluate the efficacy of their proposed treatment. This approach may leave patients with an inadequate laxative dosage or inadequate enema recipe, leading to increased patient and family frustration, recurrent bowel accidents, and the false impression that they do not respond to bowel management treatment.



Fig. 5 Contrast enema in a patient with repaired anorectal malformation and a non-dilated colon. The post-evacuation image shows the elimination of the majority of the contrast material

Fig. 6 Patients receiving laxatives or enemas, according to their diagnosis

Laxatives (diagnosis and # of patients)		Enemas (Diagnosis and # of patients)	
ARM (unknown type)	78	ARM (unknown type)	61
Idiopathic Constipation	135	Idiopathic Constipation	45
Hirschsprung	50	Hirschsprung	39
Spina Bifida	6	Spina Bifida	72
Recto-perineal fistula	59	Recto-perineal fistula	12
Recto-vestibular fistula	17	Recto-vestibular fistula	17
Recto-bladder neck fistula	8	Recto-bladder neck fistula	17
Cloaca	16	Cloaca	75
Recto-urethral bulbar	7	Recto-urethral bulbar	5
No fistula	3	No fistula	7
Recto-urethral prostatic	2	Recto-urethral prostatic	1
Complex malformation	2	Complex malformation	10
Total	383	Total	361

In Europe, there has been publications about the use of hydrocolonic sonography for bowel management [9, 10]. For daily assessment of stool load during a bowel management week, abdominal radiographs seem to be preferred in the USA, as they have lower cost, are fast, and less

dependable on the child's cooperation. They also provide easy visual assessment for both radiologists and clinicians.

Regarding the concern about radiation over abdominal radiographs, the average radiation for an abdominal radiograph at Children's Hospital Colorado is 0.06 mSv



Fig. 7 Abdominal radiograph done after enema treatment and evacuation shows a clean rectum, left colon, and transverse colon. Stool is seen in the right colon



Fig. 8 Abdominal radiograph showing stool in the rectum and left colon

(Fig. 14), which is similar to one day of background radiation [11].

Over many years performing bowel management, we realized that there is no standardized reporting of abdominal radiographs during a bowel management week. Improving the radiograph reports may facilitate clinicians' success.

We understand that the problem can only be solved if both sides (clinician ordering the radiograph and radiologist interpreting the results) aim to understand each other's needs. The clinician placing the order for the abdominal radiograph must state the diagnosis of the patient, as well as the treatment modality (enemas vs. laxatives) and the goal of the treatment being implemented during a bowel management week. The radiologist should be familiarized with the goals of the treatment and how his/her interpretation will guide the clinician on the treatment modification.

The goal of the bowel management week of patients with idiopathic constipation is to determine the amount of stimulant laxatives capable of emptying the colon, as radiologically demonstrated. Many of our patients were considered non-manageable because the constipation problem persisted after administering laxatives using the "recommended" dosage. In such cases, an abdominal radiograph allowed us to confirm that the colon was full of stool and that the patient required a much higher amount of laxative to be able to empty his/her colon. This repeated experience led us to conclude that the only objective way to determine whether the patient is receiving the right amount of laxative is with an abdominal radiograph.

In the process of finding the right amount of stimulant laxative or the right enema recipe, several abdominal radiographs are taken to guide us by trial and error to find the ideal management.

An informed radiologist needs to become involved in the process. A radiologist not educated about the plan may be distracted by reading other less important aspects of the abdominal radiograph that will have limited value for the bowel management purpose of the exam. The importance of correlation with the initial contrast enema and comparison with the previous day must be emphasized.

We propose a method of standardized interpretation as following:

Small bowel: (dilated or non-dilated).

Each colon segment should be reported as: (air filled/fluid filled/small volume of stool (non-distended)/moderate volume of stool (formed stool filling approximately 50% of the lumen) and large amount of stool (formed stool occupying



Fig. 9 Patient with cloacal exstrophy, performing bowel management with enemas through the stoma. Daily radiographs showing decreased stool volume

the entire colon lumen) or markedly distended as seen with colon segment distended with formed stool). A comment on

if the volume has increased or decreased since the day prior would also be helpful.

Fig. 10 **A** Abdominal radiograph showing fecal impaction. **B** Clean radiograph after the protocol of disimpaction

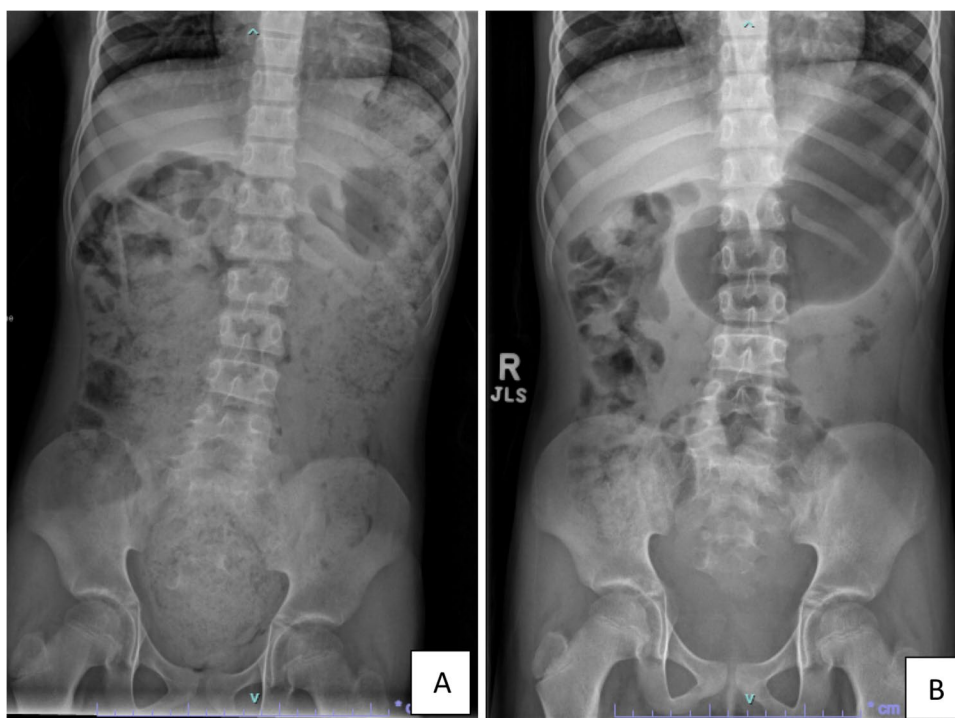




Fig. 11 Patient with an anorectal malformation during bowel management with laxatives. Abdominal radiograph shows persistent stool in the rectum

Colonic segments should be broken into 5 categories including the following:

1. Right colon
2. Transverse colon
3. Left colon
4. Rectosigmoid colon
5. Rectal vault

Abdomen: No free air, No pneumatosis.

Conclusion

Providing information regarding which treatment modality (enema vs. laxatives) the patient is receiving and stating that a patient is on a bowel management week treatment is crucial for the radiologist to provide adequate interpretation. The radiologist must be familiar with the treatment process and goals to provide a meaningful radiograph interpretation.

Fig. 12 Patient with idiopathic constipation during bowel management with laxatives. **A** Abdominal radiograph with a moderate amount of stool in the rectum and entire colon. **B** Abdominal radiograph with a decreased amount of stool, now with a small amount in the rectum only

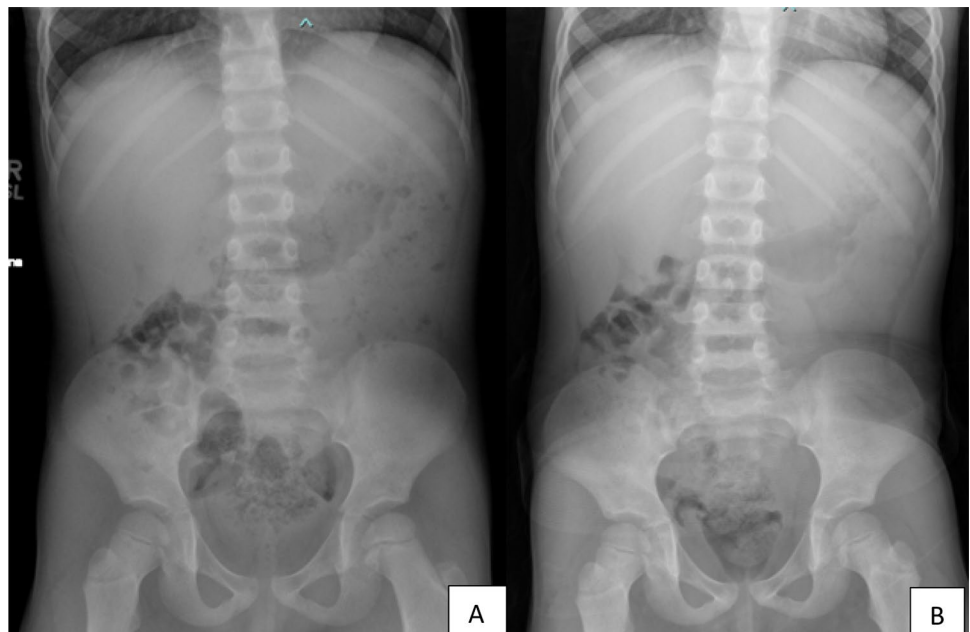


Fig. 13 Patient with idiopathic constipation during bowel management with laxatives. **A** Abdominal radiograph with a large amount of stool in the rectum, transverse and right colon. **B** Clean abdominal radiograph after the laxative dose was increased



X-ray Abodmen 1 View kV	mAs	SOD (cm)	ESD (mGy)	ED ICRP103 (mSv)	
newborn	65	1	88	0.055493134	0.01
1 yr	70	1	88	0.064358902	0.011
6 yr	70	3	85	0.206946159	0.03
10-13 yr	81	3	80	0.32275125	0.04
18 yr	81	5	80	0.53791875	0.062

Fig. 14 Abdominal radiograph radiation dosage at Children's Hospital Colorado

Author contributions AB wrote the manuscriptAll other authors edit and reviewed the manuscript

Data availability The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Conflict of interest The authors declare no competing interests.

References

1. Bischoff A, Levitt MA, Bauer C et al (2009) Treatment of fecal incontinence with a comprehensive bowel management program. *J Pediatr Surg* 44:1278–1284
2. Bischoff A, Levitt MA, Peña A (2009) Bowel management for the treatment of pediatric fecal Incontinence. *Pediatr Surg Int* 25:1027–1042
3. Bischoff A, Tovilla M (2010) A practical approach to the management of pediatric fecal incontinence. *Semin Pediatr Surg* 19:154–159
4. Bischoff A, Brisighelli G, Dickie B et al (2018) Idiopathic constipation: a challenging but manageable problem. *J Pediatr Surg* 53:1742–1747
5. Saadai P, Trappey AF, Goldstein M et al (2019) Guidelines for the management of postoperative soiling in children with Hirschsprung disease. *Pediatr Surg Int* 35:829–834
6. Schletker J, Edmonds T, Jacobson R et al (2019) Bowel management program in patients with spina bifida. *Pediatr Surg Int* 35:243–245
7. Stevens J, De La Torre L, Hall J et al (2022) The importance of dedicated colorectal team participation in the management of spina bifida and spinal cord injury patients. *Pediatr Surg Int* 38:69–74
8. Levitt MA, Mak GA, Falcone RA et al (2008) Cloacal exstrophy—pull through or permanent stoma? A review of 53 patients. *J Pediatr Surg* 43:164–170

9. Marzheuser S, Schmidt D, David S et al (2010) Hydrocolonic sonography: a helpful diagnostic tool to implement effective bowel management. *Pediatr Surg Int* 26:1121–1124
10. Grasshoff-Derr S, Backhaus K, Hubert D et al (2011) A successful treatment strategy in infants and adolescents with anorectal malformation and incontinence with combined hydrocolonic ultrasound and bowel management. *Pediatr Surg Int* 27:1099–1103
11. Wahl LE (2010) Environmental Radiation. Health Physics Society Specialist in Radiation Safety. Fact Sheet. https://hps.org/documents/environmental_radiation_fact_sheet.pdf. Accessed 23 June 2023

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.