

UC San Diego

UC San Diego Previously Published Works

Title

Resurgence of intestinal ascariasis among adults: radiological diagnosis and clinical implications

Permalink

<https://escholarship.org/uc/item/1nh9n9bd>

Journal

Abdominal Radiology, 47(3)

ISSN

2366-004X

Authors

Ghahremani, Gary G

Hahn, Michael E

Publication Date

2022-03-01

DOI

10.1007/s00261-022-03407-6

Peer reviewed



Resurgence of intestinal ascariasis among adults: radiological diagnosis and clinical implications

Gary G. Ghahremani¹ · Michael E. Hahn¹

Received: 4 December 2021 / Revised: 30 December 2021 / Accepted: 31 December 2021 / Published online: 11 January 2022
© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2022

Abstract

To report the radiological features of intestinal ascariasis and to review the clinical implications of this re-emerging disease for adult population of the USA. This retrospective observational study involved 12 adult patients, whose radiological examinations disclosed unsuspected presence of ascaris in their intestinal tract. They were evaluated by computed tomography of the abdomen with oral contrast, small bowel series with barium, and magnetic resonance enterography. This series included 7 men and 5 women, who ranged in age from 19 to 72 years (mean age 48 years). The typical configuration of ascaris within the bowel loops was demonstrated on CT of the abdomen in 5 patients, small bowel examination with barium in 3, and by MR enterography in another 4 cases. Our study highlights the radiological appearances of intestinal ascariasis and the clinical implications of this resurging disease. The practicing radiologists should be aware of these findings, particularly when examining patients who have immigrated from or traveled to the endemic regions.

Keywords Intestinal ascariasis · Radiological diagnosis · Computed tomography · Magnetic resonance enterography

Introduction

Ascariasis is the most common form of soil-transmitted worm infestation in the world, affecting an estimated 1.2 billion people in the tropical regions of Asia, Africa, and Latin America [1, 2]. It had been estimated previously that nearly 4 million people in the USA were infected with ascaris, but the majority of them either lived in the Southeastern States or they were immigrants from developing countries with a high prevalence of this disease. However, ascariasis had become very uncommon in the USA over the past several decades because of the improved sanitation, hygiene practices, and public health programs [1–3].

Almost all of the published reports about ascariasis in English medical literature of the last 20 years involved patients from countries in the endemic areas [3–8]. One exceptional case was an African–American native of New

York, who had contracted this infestation during frequent visits to South Carolina [9]. It should be noted that the Southeastern States with their humid temperate climate would be an area susceptible to this disease, particularly because the global warming has further expanded the natural habitat of this parasite.

Several recent reports have raised concern about the resurgence of ascariasis among the population of the USA [2, 10–18]. The contributing factors that are mentioned in these publications include large number of immigrants and refugees from the endemic areas who may transmit the infection to others [11–15], international travel by tourists, expatriates and military personnel living abroad, increased consumption of organic produce that can be contaminated by fertilizers containing fecal matter or raw sewage [1–4, 19], poverty and unsanitary living condition of homeless individuals [16, 17], and spread of infestation by homosexuals [18].

The aim of this article is to report our experience with 12 patients whose radiological studies revealed unsuspected intestinal ascariasis and to review the pertinent literature regarding the clinical implications of this re-emerging disease.

✉ Gary G. Ghahremani
gghahremani@ucsd.edu

Michael E. Hahn
mehan@ucsd.edu

¹ Department of Radiology, University of California-San Diego Medical Center, 200 West Arbor Drive, San Diego, CA 92103, USA

Methods

We retrospectively reviewed the medical and radiological records of 12 adult patients, in whom one or several elongated tubular structures consistent with configuration of round worms had been visualized within their intestinal lumen.

This series consisted of 7 men and 5 women, who ranged in age from 19 to 72 years (mean age 48 years). They were evaluated by computed tomography (CT) of the abdomen with oral and intravenous contrast material in 5 patients. Small bowel examination with barium was done in 3 and with Gastrografin in another patient and compression spot films were obtained during their fluoroscopic evaluation.

Magnetic resonance (MR) enterography was carried out in 4 patients, using General Electric 1.5 T equipment after oral administration of 0.5 to 1.0 l of low-concentration barium sulfate suspension (VoLumen) and intravenous injection of 1 mg glucagon. Multiplanar and multisequence MR images were then acquired prior to and following enhancement with intravenous gadolinium-based contrast material. We used the same technique and protocol as described in detail by other authors [20], but the particular MR pulse sequences were mostly T2 weighted with fat suppression as listed in the captions of illustrated cases. These imaging studies had been performed during the period 2010–2019 at our University Medical Center.

Results

Abdominal CT findings

The presence of unsuspected ascaris in the intestinal tract of 5 patients was demonstrated on CT of the abdomen. Their clinical histories and demographics are briefly mentioned to highlight the primary reason for the radiological examinations.

A 66-year-old Filipino man with prostate cancer was referred for CT of the abdomen with oral and intravenous contrast in order to stage the tumor prior to treatment. The obtained images disclosed two ascaris in the proximal loops of jejunum (Fig. 1).

A 20-year-old American student had returned from a 6-month service with the U.S. Peace Corp in Africa, complaining of cramping abdominal pain, nausea, vomiting, and weight loss. His CT images showed ascaris in the jejunum and gallbladder (Fig. 2A). Ultrasound evaluation of the gallbladder confirmed a single ascaris within its lumen. The patient was then given 120 ml of Gastrografin to drink



Fig. 1 CT images of intestinal ascariasis in a Filipino man. **A** Axial view shows a worm in the jejunum (arrow). **B** Coronal view demonstrates the long body of an ascaris with its opacified intestine (large arrow) and another one in cross-section (small arrow)

and subsequent fluoroscopic study revealed several intestinal worms (Fig. 2B).

The other 3 male patients had CT examination because of recurrent abdominal pain, obstructive symptoms, or follow-up of prior intestinal surgery. In each of them the intraluminal contrast outlined one or several ascaris worms (Fig. 3A–C).

Findings on small bowel series

Small bowel examinations with barium had been performed in 3 patients, whose main complaints were recurrent abdominal pain, diarrhea, and weight loss. They included a 23-year-old Mexican woman with intermittent colicky pain that was thought initially to be caused by peritoneal adhesions after her open cholecystectomy (Fig. 4A), a 46-year-old man who had been a recent immigrant from Afghanistan (Fig. 4B), and a 36-year-old homosexual man with history of AIDS and intestinal cryptosporidium infection. It is of interest to note that at the time of fluoroscopy all 3 patients admitted that

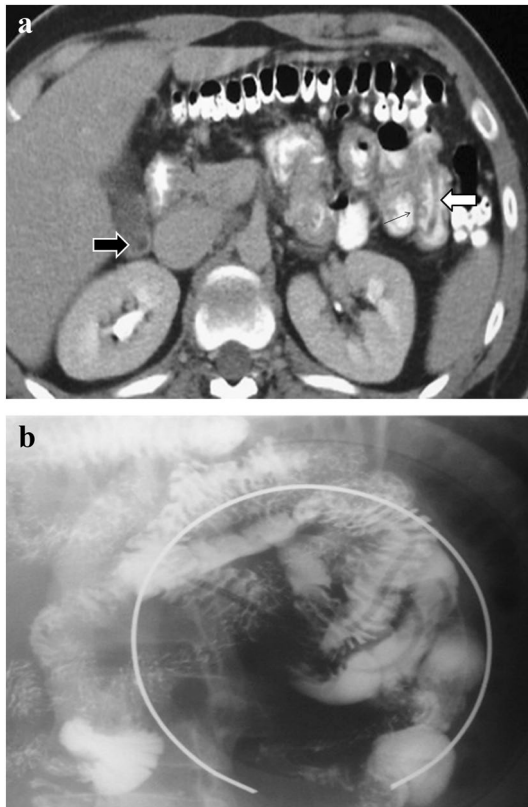


Fig. 2 **A** CT of the abdomen in this American student shows one ascaris in the jejunum (white arrow) and some others in cross-section (small black arrow). There is also an ascaris within the gallbladder (large black arrow) that was confirmed by sonography. **B** Small bowel examination with Gastrografin clearly shows several worms in the jejunum

they had been treated for ascariasis during their childhood, but were unaware of its recurrence.

Findings on MR enterography

MR enterography was carried out in 4 patients for further evaluation of their already known intestinal diseases. A 32-year-old Arab woman with prior subtotal colectomy and an ileo-sigmoid anastomosis for Crohn's colitis presented to the Emergency Department because of an acute episode of abdominal pain and diarrhea. MR enterography disclosed recurrent inflammation of distal ileum and a tubular structure suggestive of an ascaris in the proximal jejunum (Fig. 5A, B). Another MR enterography performed 1 year later again showed similar worms in the small bowel (Fig. 5C, D).

A 67-year-old woman with longstanding Crohn's disease of distal ileum underwent MR enterography for recurrent symptoms. It showed some parts of a dead ascaris in the descending colon and sigmoid, most likely being discharged there by the large volume of administered fluid during the procedure (Fig. 6A, B).

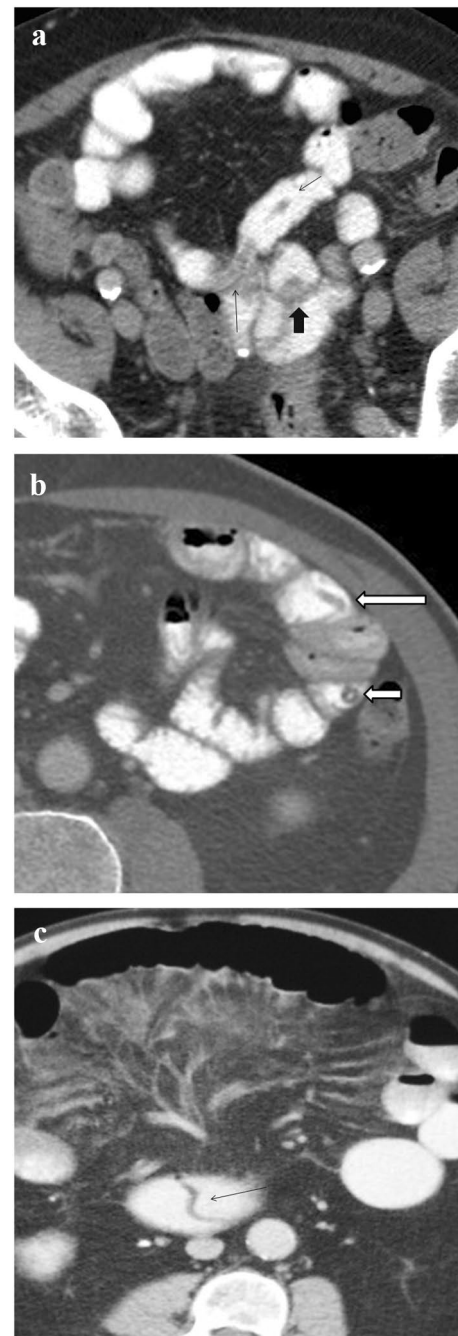


Fig. 3 CT demonstration of ascariasis in 3 different patients. **A** One worm is seen longitudinally (small arrows) and another in cross-section (large arrow). **B** The body of one ascaris is partly visible (long arrow), while the cross-section of another one is seen with opacified gut in its center (short arrow). **C** CT image shows a juvenile ascaris in the distal duodenum (arrow), but several similar worms were also present within the distended small bowel loops

MR enterography in a 19-year-old girl with early Crohn's disease of distal ileum demonstrated several worms in the proximal jejunum and ileum (Fig. 7A, B).

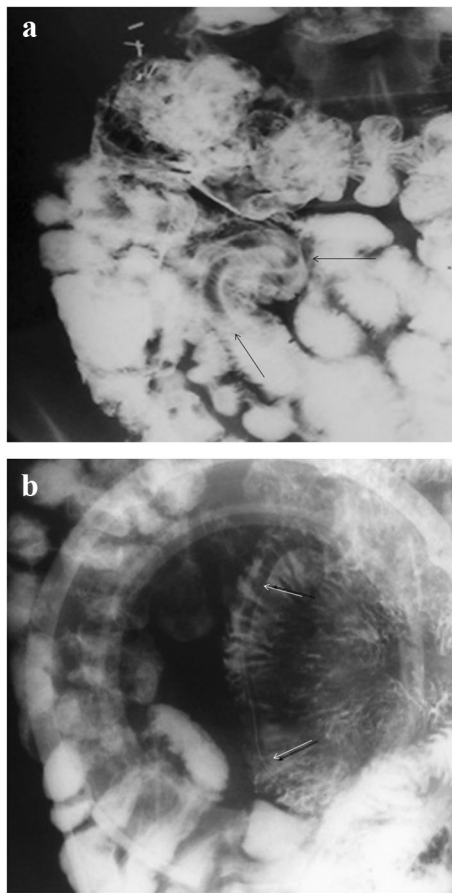


Fig. 4 Small bowel examinations with barium showing ascariasis in 2 patients. **A** Two adjacent worms were detected in the ileum of this Mexican woman with intermittent abdominal cramping pain after cholecystectomy (arrows). **B** Radiograph from the small bowel series of this immigrant from Afghanistan shows an ascaris with partially opacified intestinal tract (arrows)

The oldest patient in this series was a 72-year-old woman with prior liver transplant for cirrhosis, who had MR enterography for the staging of her newly diagnosed colon carcinoma. Incidentally demonstrated abnormality was the presence of suspicious worms in jejunal loops (Fig. 8A, B).

It should be noted that 2 of these patients had prior CT enterography for the evaluation of their inflammatory bowel disease. However, the low-density fluid used to distend the small bowel loops made it difficult to visualize the presence of any intraluminal worm.

The referring physicians of 8 patients were informed about the radiological findings of intestinal ascariasis, thus prompting subsequent stool tests for parasite ova and treatment with Albendazole. However, follow-up small bowel series were not performed to document the actual disappearance of these worms. It should also be noted that the radiology reports in 4 patients who had MR enterography had not mentioned the presumptive diagnosis of ascariasis.

This finding was first recognized during our retrospective review of 160 MR enterography examinations performed during the past decade.

Discussion

Radiological studies can play an important role in the detection of unsuspected ascariasis at this time of its apparent resurgence, as evident by our experience and other published reports [4, 6, 21, 22]. The most accurate method for demonstrating the actual size and number of these worms is the small bowel examination with barium or Gastrografin (Figs. 2B, 4), although this technique has been largely replaced by CT and MR enterography [20, 23–25].

Ascaris usually inhabits in the loops of jejunum, but can also migrate into the biliary and pancreatic ducts, stomach, colon, appendix, and other organs. A mature male *ascaris* measures 15–30 cm in length and 2–4 mm in diameter. The female worm is slightly larger and releases many thousands of microscopic eggs per day. These ova can remain viable in the soil for several months or years, thereby becoming the main source of transmission to the human host.

Ingestion of contrast material by the worms will cause opacification of their intestinal tract as a thin-longitudinal line bisecting their body (Figs. 1B, 4B). The same feature on cross-section of *ascaris* will appear as a radiopaque dot at the center of its round body (Figs. 1B, 3B), resembling a target sign on CT images [4–6, 26]. Because the body of *ascaris* is usually bent or curved, only parts of it as a 5–10 cm segment can be seen on the axial or coronal images of CT or MR studies. However, its opacified gut can be a helpful clue for differential diagnosis from elongated foreign bodies, such as undigested vegetable stems or dislodged parts of broken nasojejunal feeding tubes [27]. It should be noted that barium ingestion is unique to *ascaris* and usually occurs during examination of fasting patients. This finding also serves to distinguish it from tapeworm, whose segmented body does not have such an alimentary tract [6, 21, 26].

The common species of roundworm found in the human intestinal tract is *Ascaris lumbricoides*, but a similar type called *Ascaris suum* can infect the individuals handling pigs or their infected manure [1–3]. Tapeworms are recognized by their flat-segmented body and the length of several meters. Whipworms are up to 5-cm long and their whip-like front is attached to the colonic wall. Hookworms are only 5–10 mm and can be transmitted by infected cats and dogs. The clinical diagnosis of various soil-transmitted helminth infections is usually made by stool examination for eggs and molecular diagnostic tests [28].

There have been isolated reports of detecting heavy *ascaris* infestation on plain abdominal radiographs. Ellman and associates described the findings as a cluster of round

Fig. 5 MR enterography in June 2018 (**A, B**) reveals the appearance of an ascaris in the jejunum (arrow) of this young Arab woman with subtotal colectomy for Crohn's colitis. Re-examination in July 2019 (**C, D**) again shows the small bowel worms (arrows). **A** Axial T2-weighted SSFSE. **B–D** Axial T2 with fat suppression

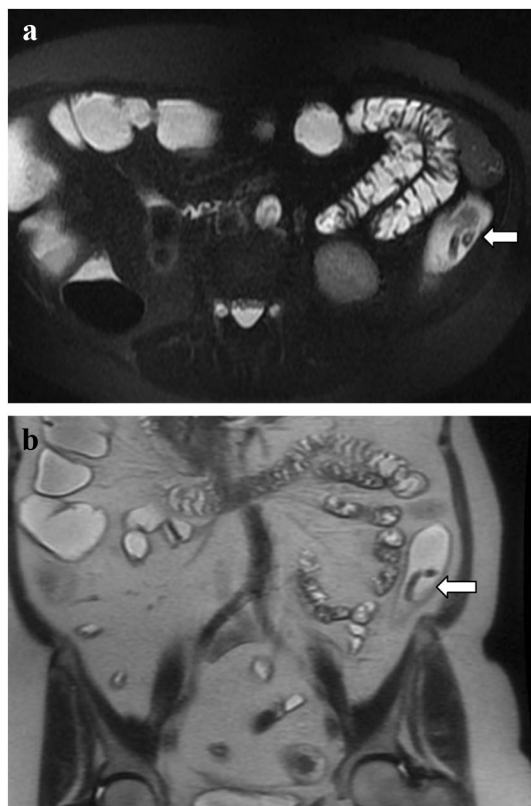
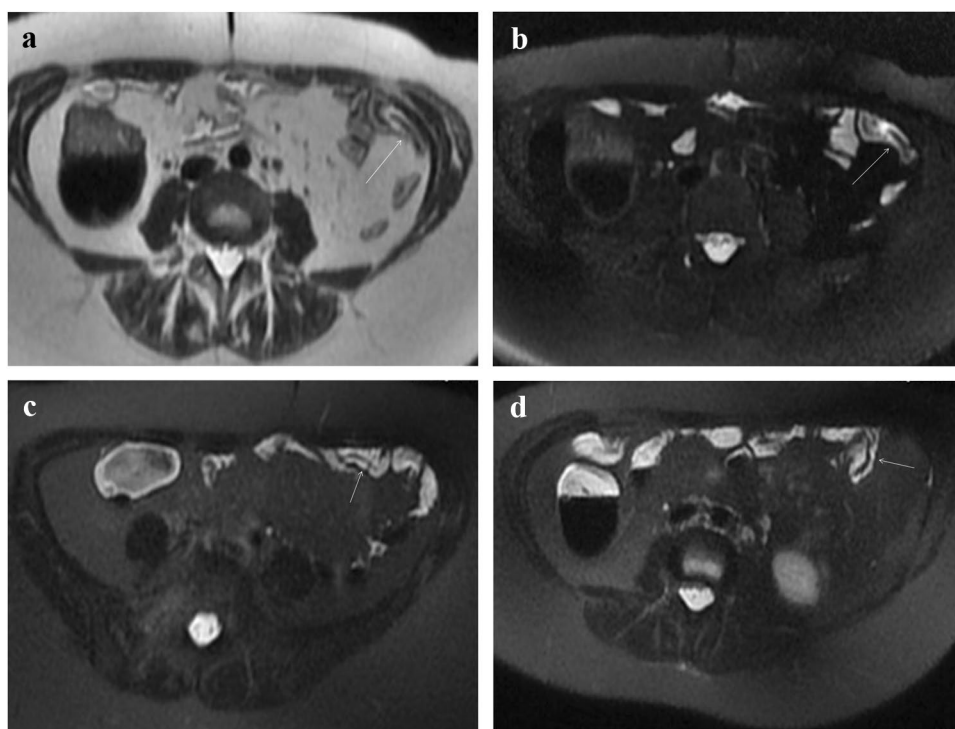


Fig. 6 MR enterography images demonstrate different parts of a dead ascaris in the descending colon (arrow). **A** Axial T2-weighted SSFSE with fat suppression. **B** Coronal T2-weighted sequence

nodules or tangled cords within the intraluminal gas [29]. Rodriguez et al. reported the appearance of multiple tubular structures within the gas-distended small bowel loops [30]. On abdominal radiographs obtained 1–3 days after small bowel series, the retained barium in the worms' digestive tract can be visible as radiopaque thread-like filaments [6, 29].

The sonographic appearance of ascaris worms has been described as parallel pairs of hyperechoic lines reflecting their surface with hypoechoic center of their body on longitudinal image and as a 4–5 mm round mass with doughnut shape or target sign on cross-section view. Their serpentine movement can be recognized during real-time observation [3, 6, 7, 31].

As noted earlier 2 of the patients who had MR enterography had also undergone prior CT enterography for evaluation of their Crohn's disease. The oral administration of low-density fluid used during this examination did not allow visualization of intraluminal worm at that time or even on our retrospective review. Therefore, either CT with radioopaque oral contrast or small bowel series should be the preferred methods for the radiological diagnosis of intestinal ascariasis (Figs. 1, 2, 3, 4). Various radiological modalities and features that can be used to diagnose this infestation are summarized in Table 1.

The value of MR imaging in patients with hepatobiliary ascariasis has been reported by several authors [6, 8, 32, 33]. Although this technique can depict intestinal worms, it is less accurate compared to CT of the abdomen with oral

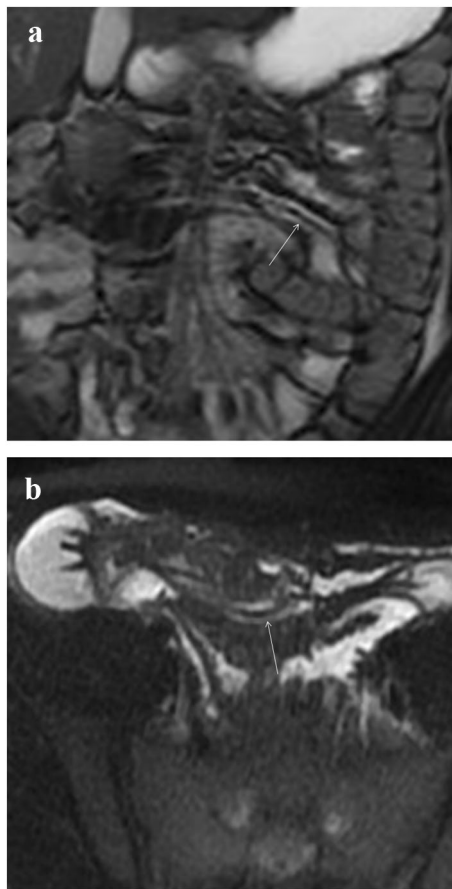


Fig. 7 Coronal (A) and axial (B) images of MR enterography in this 19-year-old girl demonstrate 2 of several worms in the jejunum and ileum (arrows). **A** FIESTA and **B** T2W, SSFSE with fat sat

contrast because it takes longer to perform and more susceptible to breathing or motion artifacts. To the best of our knowledge, our 4 cases are the first reported instances of detecting intestinal ascariasis by MR enterography (Figs. 5, 6, 7, 8).

About 80% of patients with intestinal ascariasis are either asymptomatic or have only mild abdominal pain and discomfort. However, a cluster of worms can cause bowel obstruction and interfere with protein resorption, particularly in children [4–6]. They can also lead to some systemic effects related to development of asthma and allergy during childhood [19, 34, 35]. Although only one patient in this series had an ascariis in his gallbladder (Fig. 2A), there have been multiple reports concerning the involvement of biliary and pancreatic ducts in this disease [3, 6–8, 32, 33].

Recent publications have attributed the resurgence of ascariasis among the population of the USA to several factors [2, 10–18]. Major emphasis has been placed on the potential transmission of this disease by the large number of immigrants and refugees from the endemic regions, who resettle in this country each year. Varkey et al. found that

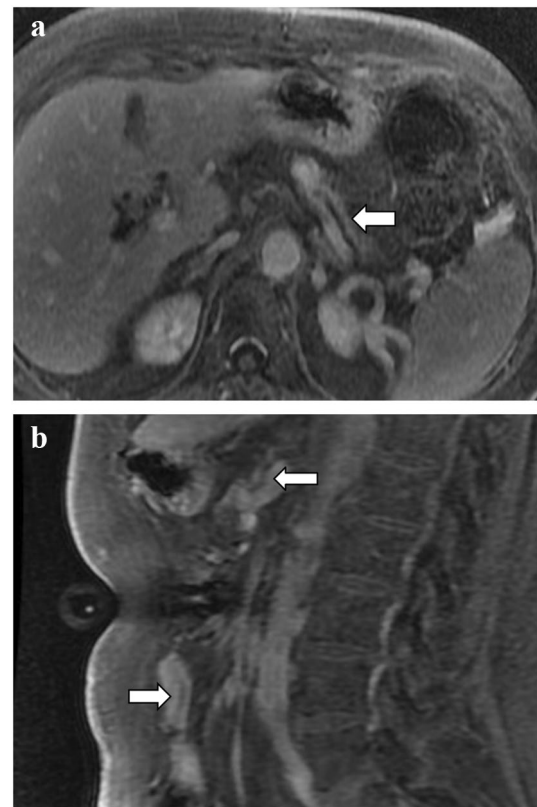


Fig. 8 MR enterography images in axial (A) and sagittal (B) view show several suspected ascariis in the small bowel of this patient (arrows). **A** and **B** T1 weighted with fat suppression and intravenous contrast enhancement

19% of 10,358 refugees in Minnesota had intestinal parasites [14]. Geltman and associates reported that 56% of 1254 refugees resettled in Massachusetts had parasites and 14% of them harbored ascariis and other worms [15]. These findings have led to the establishment of various programs by CDC and World Health Organization for the screening and treatment of such infestations [1, 11–13].

It is of interest to note that 5 of our 12 patients were immigrants or had previously lived in the endemic regions of the world. Therefore, it would be important to carefully evaluate the CT and MR images of such patients in search for possible intestinal ascariasis. The same approach should be considered during radiological examinations of homeless individuals living in unsanitary conditions, homosexuals, and vegetarians consuming fresh organic products that can be contaminated by the ascariis ova contained in natural fertilizers [1, 2, 10, 16–19].

Limitations

Statistical data concerning the current incidence of ascariasis in the USA are not yet available, but the cited articles

Table 1 Radiological diagnosis of intestinal ascariasis

Imaging modality	Pre-requisite	Observed features of ascariasis	References
Abdominal radiograph	Gas-filled intestine	Clusters of round or tubular masses outlined by the intestinal gas content	[4, 6, 29, 30]
Abdominal radiograph	Prior barium meal study	Radiopaque thread-like filaments due to ingested barium in the ascaris gut lumen	[4, 6, 29, 30]
Small bowel series	Barium or Gastrografin	Elongated tubular structures in the small bowel, some bisected by a radio-paque line	[4–6, 26]
Computed tomography	Oral contrast material	Elongated cylindrical or round soft issue masses with central point or linear opacity, within the intraluminal contrast of small bowel	[21, 22, 26, 33]
MR enterography	Glucagon and VoLumen	Cord-like or spaghetti-shaped structures within the intestinal loops	[6, 32, 33]
Abdominal sonography	Fluid-filled intestine	Pairs of hyperechoic parallel lines with hypoechoic center, serpentine movement on real-time imaging, and round target sign appearance on cross-sectional view	[6, 7, 30, 31]

indicate its recent increase [2–18]. The concern we have expressed in this report about the resurgence of intestinal ascariasis is based on encountering these 12 patients within the past decade, whereas only 4 such cases were diagnosed during the prior 4 decades of clinical practice by the senior author. However, our findings in a rather small series of patients would require further assessment regarding the actual prevalence of this disease among a larger population.

Conclusion

Although the imaging of intestinal ascariasis is the main subject of this article, the increasing incidence of this infestation among the USA population would have significant clinical implications because various other abdominal organs can also be affected. It is hoped that the information provided herein will further enhance the knowledge of practicing physicians and radiologists regarding the diagnosis and management of this re-emerging disease.

Declarations

Conflict of interest The authors declare that they have no conflict of interest. The authors declare that they have no disclosure relevant to the subject matter of this article.

Ethical approval Due to the retrospective review of the already performed and medically warranted examinations, the patients consent and IRB approval were waived.

References

- Parasites-Ascariasis. Center for Disease Control and Prevention. November 23, 2020. Retrieved from <https://www.cdc.gov>.
- Leung AKC, Leung AAM, Wong AHC, Hon KL (2020) Human ascariasis: an updated review. *Recent Pat Inflamm Allergy Drug Discov* 14: 133–145.
- Khuroo MS (1996) Ascariasis. *Gastroenterol Clin North Am* 25: 553–577.
- Ortega CD, Ogawa NY, Rocha MS, et al (2010) Helminthic disease in the abdomen: an epidemiologic and radiologic overview. *RadioGraphics* 30: 253–267.
- Khan MW, Ghauri SK (2016) Small bowel ascaris infestation: a diagnostic challenge. *Int J Gen Med* 9: 99–101.
- Das CJ, Kumar J, Debnath J, Chaudhry A (2007) Imaging of ascariasis. *Australas Radiol* 51: 500–506.
- Wu S (2009) Sonographic findings of *Ascaris lumbricoides* in the gastrointestinal and biliary tracts. *Ultrasound Q* 25: 207–209.
- Khuroo MS, Rather A, Khuroo NS, Khuroo MS (2016) Hepatobiliary and pancreatic ascariasis. *World J Gastroenterol* 22: 5707–17.
- Kanneganti K, Makker JS, Remy P (2013) *Ascaris lumbricoides*: to expect the unexpected during routine colonoscopy. *Case Rep Medicine* 2013: e579463.
- Hillyer JF (2020) Parasites and parasitology in this SARS-Cov-2, COVID-19 world: an American Society of Parasitologists Presidential Address. *J Parasitol* 106: 859–868.
- Mitchell T, Lee D, Weinberg M, et al (2018) Impact of enhanced health interventions for US-bound refugees: evaluating best practices in migration health. *Am J Trop Med Hyg* 98: 920–928.
- Darr JS, Conn DB (2015) Importation and transmission of parasitic and other infectious diseases associated with international adoptees and refugees immigrating into the United States of America. *Biomed Res Int* 2015: e763715.
- Swanson SJ, Phares CR, Mamo B, et al (2012) Albendazole treatment and enteric parasites in the United States-bound refugees. *N Engl J Med* 366: 1498–1507.
- Varkey P, Jerath AU, Bagniewski S, Lesnick T (2007) Intestinal parasitic infection among new refugees to Minnesota, 1996–2001. *Travel Med Infect Dis* 5: 223–229.
- Geltman PL, Cochran J, Hedgecock C (2003). Intestinal parasites among African refugees resettled in Massachusetts and the impact of an overseas pre-departure treatment program. *Am J Trop Med Hyg* 69: 657–662.
- Morse SS (1995) Factors in the emergence of infectious diseases. *Emerg Infect Dis* 1: 7–15.
- Hotez PJ, Molyneux DH, Fenwick A, et al (2007) Control of neglected tropical diseases. *N Engl J Med* 357:1018–1027.
- Abdolrasouli A, McMillan A, Ackers JP (2009) Sexual transmission of intestinal parasites in men who have sex with men. *Sex Health* 6: 185–194.
- Holland C (2013) *Ascaris: The Neglected Parasite*. Elsevier Academic Press, Amsterdam, pp 21–50.

20. Amzallag-Bellenger E, Oudjit A, Ruiz A, et al (2012) Effectiveness of MR enterography for the assessment of small bowel diseases beyond Crohn disease. *RadioGraphics* 32: 1423–1444.
21. Park MS, Kim KW, Ha HK, Lee DH (2008) Intestinal parasitic infection. *Abdom Imaging* 33: 166–171.
22. Sinha R, Rajesh A, Rajiha P, Rachandran I (2012) Infections and infestations of the gastrointestinal tract. Part 2: Parasitic and other infections. *Clin Radiol* 67: 495–504.
23. Ilangovan R, Burling D, George A, et al (2012) CT enterography: review of technique and practical tips. *Br J Radiol* 85: 876–886.
24. Fletcher JG (2009) CT enterography technique: theme and variations. *Abdom Imaging* 34: 283–288.
25. Fidler JL, Guimaraes L, Einstein DM (2009) MR imaging of the small bowel. *RadioGraphics* 29: 1811–1825.
26. Hommeyer SC, Hamill GS, Johnson JA (1995) CT diagnosis of intestinal ascariasis. *Abdom Imaging* 20: 315–316.
27. Prabhakaran S, Doraiswamy VA, Nagaraja V, et al (2012) Nasoenteric tube complications. *Scand J Surg* 101:147–155.
28. Jourdan PM, Lamberton PHL, Fernwick A, Addiss DG (2018) Soil-transmitted helminth infections. *Lancet* 391: 252–265.
29. Ellman BA, Wynne JM, Freeman A (1980) Intestinal ascariasis: new plain film features. *AJR* 135: 37–42.
30. Rodriguez EJ, Gama MA, Ornstein SM, Anderson WD (2003) *Ascaris* causing small bowel volvulus. *RadioGraphics* 23: 1291–1293.
31. Mahmood T, Mansoor N, Quraishy S, et al (2001) Ultrasonographic appearance of *Ascaris lumbricoides* in the small bowel. *J Ultrasound Med* 20: 269–274.
32. Hwang CM, Kim TK, Ha HK, et al (2001) Biliary ascariasis: MR cholangiography findings in two cases. *Korean J Radiol* 2: 175–178.
33. Ng KK, Wong HF, Kong MS, et al (1999) CT, MR cholangiopancreatography, and navigator endoscopic appearance-report of a case of acute biliary obstruction. *Abdom Imaging* 24: 470–472.
34. Venkatachalam PS, Patwardhan VN (1953) The role of *Ascaris lumbricoides* in the nutrition of the host: effect of ascariasis on digestion of protein. *Trans Royal Soc Trop Med Hyg* 47: 169–175.
35. Amoah AS, Boakye DA, Van Ree R, Yazdanbakhsh M (2014) Parasitic worms and allergies in childhood: insights from population studies 2008–2013. *Pediatr Allergy Immunol* 25: 208–217.

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