

Sonographic Appearance of Different Presentations of Ascariasis in a Tertiary Care Centre in West Bengal - A Case Series and Review of Imaging Features

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ABSTRACT

BACKGROUND

Ascariasis is a type of roundworm infestation caused by the helminth *Ascaris lumbricoides*. In spite of advancements in the diagnosis and management of ascariasis, it remains one of the commonest infections in the world, especially in the tropical and subtropical countries, causing both acute and chronic illnesses. Ultrasound offers a quick and non-invasive way to diagnose ascariasis of the intestine and hepatobiliary system. In this study we have described the imaging appearance of ascariasis through a series of cases and demonstrated key imaging characteristics according to location.

METHODS

This is an institution based observational and descriptive study. A cross-sectional study was conducted in the Department of Radiodiagnosis of North Bengal Medical College & Hospital for a period of 15 months (Oct 2018 - Jan 2020). This study was conducted among the patients who were referred to the Department of Radiodiagnosis for evaluation of abdominal symptoms.

RESULTS

Intestinal and extra-intestinal ascaris worms have a typical appearance which is easily identifiable in on ultrasound, but diagnostic confidence is affected by several factors related to the patient, worms and the ultrasound technique.

CONCLUSIONS

Ultrasound is a rapid, inexpensive and easily available modality with a high success rate in diagnosing ascariasis and its complications. It is important to be aware of the characteristic appearance of ascaris in the intestines and the hepatopancreato-biliary tree and it must be remembered that the typical appearance is grossly affected by several factors such as the number, whether living or not as well as the luminal distension of the organ.

KEYWORDS

Ultrasound, Ascariasis, Intestinal Obstruction, Cholecystitis, Cholangitis, Pancreatitis, Appendicitis

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BACKGROUND

Roundworm infestation is the most common helminthic infection affecting almost a quarter of the human population in this world.¹ It is caused by *Ascaris lumbricoides*. It has a higher prevalence in developing countries and is endemic in India and forms a major burden of parasitic diseases.

The life cycle of the worm begins with the embryonated eggs which when shed by the adult worm, are subsequently passed through the stool of the patient. These eggs can then contaminate soil, water, or even food. The infection occurs in humans after ingestion of the contaminated food or through poor hand hygiene.²

The embryonated eggs are the infective stage from a radiological perspective, the adult worms are the diagnostic stage usually by ultrasonography.

Ultrasonography is a very useful and effective modality at diagnosis of ascariasis.³ We can visualise the adult stage of the worms in the intestine, biliary tree or even the pancreatic duct in rare cases. An adult worm measures 15 - 30 cm long and 3 - 6 mm thick. The body of the worm has two outer layers the cuticle and hypodermis. There is a separate inner muscular layer and an alimentary tract centrally.

Existing literature on sonographic appearance of ascariasis describes the worm typically as a tubular structure with parallel lines showing curling movements on dynamic scans when live and as heterogeneous linear calcification when dead and degenerated. In this paper, we describe the appearance of live and dead worms in the intestine and biliary tree with our techniques and manoeuvres.

Objectives

To evaluate the different types of imaging appearance of ascariasis on ultrasound and describe the technique used along with the salient features.

METHODS

It is an institution based observational and descriptive study with cross-sectional study design conducted in the Department of Radio-diagnosis of North Bengal Medical College & Hospital. It included 36 patients who were referred to the Department of Radio-diagnosis for evaluation of abdominal symptoms and the sample method being complete enumeration. The study included sonologically diagnosed cases of ascariasis.

Study Tools

- Datasheet of clinical evaluation of the patient.
- Case record form.
- Informed consent form.
- USG machine with 2 – 5 MHz and 7 - 12 MHz Broadband transducer in GE LOGIQ F8, GE LOGIQ P9 and Philips HD – 7.

Study Technique

All of the 36 subjects were referred to the Department of Radio diagnosis from Departments of Medicine, Surgery, Paediatrics and Obstetrics and Gynaecology. In 25 subjects of (70 %), the diagnosis of ascariasis was made during routine abdomen examination while in the remaining subjects (30 %), the treating doctors had clinically suspected a parasitic infection.

The subjects were initially scanned according to the institutional abdominal protocol in the supine position which included assessment of the bowels with a high frequency transducer (7 - 12 m Hz) and if ascaris worms were noted, the scans were repeated after asking the patient to drink 1 litre water. In several cases the subjects were asked to change their position to left lateral decubitus to enable better visualisation in case of presence of bowel gas.

Static scans were performed with Curvilinear Transducers (2 - 5 m Hz) and Linear high frequency transducers (7 – 12 m Hz) with Colour Doppler and power Doppler. Dynamic scans were often performed by applying pressure with the transducer to induce movement by the worms to confirm if they were live or not. All the cases with sonologically diagnosed ascariasis were followed up clinically for confirmation of diagnosis and monitoring of the worm load and appearance.

Statistical Analysis

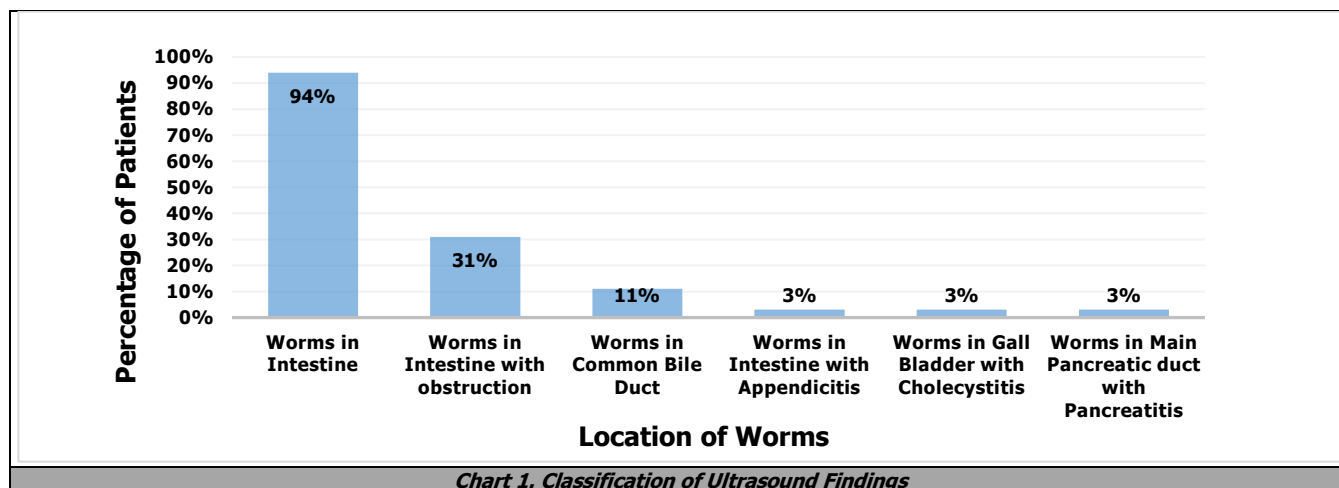
Data was checked for consistency and completeness and entered in Microsoft excel data sheet. Data was analysed by appropriate statistical software and was presented using the principle of descriptive and inferential statistics.

RESULTS

In this study we had 16 adult subjects (44 %) and 20 subjects belonging to the paediatric age group (56 %). 11 subjects were referred from the Department of Medicine (31 %), 13 from the Department of Surgery (36 %) and 10 from the Department of Paediatrics (28 %) while 2 cases of intestinal ascariasis were incidentally detected during routine antenatal scan.

The clinical features at presentation were asymptomatic in 2 subjects (5 %), abdominal pain in 19 subjects (53 %), jaundice in 3 subjects (8 %), intestinal obstruction in 11 subjects (31 %), and cough in 1 subject (3 %).

A majority of the detected parasites were in the intestine of 34 subjects (94 %) with 11 (30 %) of them showing signs of intestinal obstruction while only 1 (2.7 %) presented with acute appendicitis. 4 (11 %) subjects had worms in the common bile duct (CBD) while worms in gall bladder and main pancreatic duct were seen in 1 (2.7 %) subject each. The ultrasound findings may be classified on the basis of the location and associated findings of the worms at detection as shown in the table below (Figure 1).



Confirmation of Diagnosis

Diagnosis of ascariasis was confirmed by four methods – microbiological confirmation, endoscopic confirmation, surgical confirmation and clinical confirmation. Of the 11 (30 %) subjects who presented with features of intestinal obstruction, 6 subjects (54 %) eventually needed surgical intervention for acute intestinal obstruction while the remaining 5 subjects (46 %) were managed conservatively. Of the 6 subjects (16 %) who had surgically confirmed intestinal ascariasis, 1 also had clinical confirmation but during representation, the patient has been included in surgical confirmation as they presented with obstruction.

Features of Live Worm and Dead Worm

Apart from the detection of worms, certain imaging features also enabled us to distinguish dead worms from the live ones. Distinct echogenic parallel lines with inner hypoechoic strip, curling movement and presence of peristalsis were signs of life while we determined lifelessness based on solid echogenic appearance with loss of parallel linear architecture with internal hypoechoic stripe, loss of movement on dynamic scan and presence of calcification. Suspicious features of dead worms were seen in 8 subjects (22 %) all of whom were on deworming treatment. All of these worms (100 %) showed solid echogenic appearance and loss of movement on dynamic imaging while only 3 (37.5 %) showed the presence of calcification. The condition of the worms, treatment status of the subject and ultrasound characteristics have been summarised in Table 2.

Treatment Status	Ultrasound Features of Visualised Worms	Worm Status	Number of Subjects	(%)
Untreated	Distinct echogenic parallel lines, curling movement, peristaltic movement in worms	Live	25	69.45
On treatment	Distinct echogenic parallel lines, curling movement, peristaltic movement in worms	Live	3	8.33
On treatment	Solid echogenic tubular structure, loss of movement	Dead	5	13.89
On treatment	Solid echogenic tubular structure, loss of movement with calcification	Dead	3	8.33

Table 1. Findings of Live and Dead Worms

DISCUSSION

Roundworm infestation is the most common helminthic infection affecting humans with an estimated 1 billion infected people in this world.⁴ It is caused by *Ascaris lumbricoides*. It has a higher prevalence in developing countries and is endemic in India where it forms a major burden of parasitic diseases.

The life cycle of the worm begins with the embryonated eggs which when shed by the adult worm, are subsequently passed through the stool of the patient.² These eggs can then contaminate soil, water, or even food. The infection occurs in humans after ingestion of contaminated food or through poor hand hygiene. The Embryonated eggs are the Infective stage from a radiological perspective, the adult worms are the diagnostic stage – usually by ultrasonography.

Ultrasonography is a very useful and effective modality at diagnosis of ascariasis. We can visualise the adult stage of the worms in the intestine, Gall Bladder, Common Bile Duct or even the pancreatic duct which is due to migration of intestinal worms through the major duodenal papilla. An adult worm measures 15 - 30 cm long and 3 - 6 mm thick. The body of the worm has two outer layers the cuticle and hypodermis. There is a separate inner muscular layer and an alimentary tract centrally.⁵

On Ultrasound, the appearance of the worms depends on their orientation with respect to the probe. In the longitudinal section, the worm typically appears as a straight or curved tubular hypoechoic structure with echogenic parallel lines as shown in Figure 2A. This appearance is often referred to as the winding highway appearance.⁶ The central hypoechoic area is the alimentary system filled with fluid while the echogenic lines form the layers of the body wall. In a curvilinear transducer, typically two echogenic lines are visible separated by the hypoechoic area within while high frequency transducers show the characteristic four echogenic lines separated by three hypoechoic strips.⁷

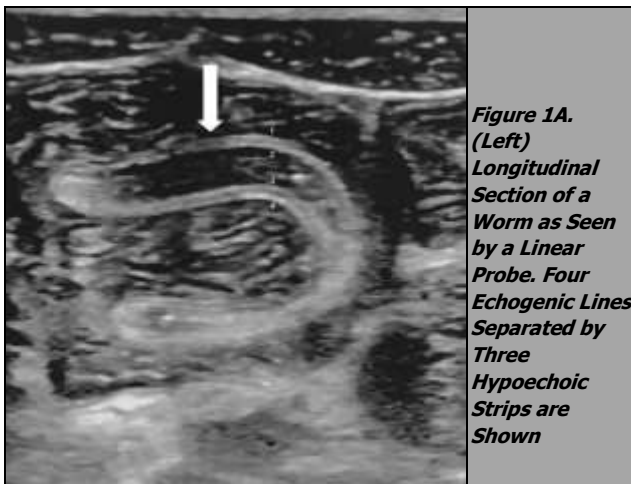


Figure 1A. (Left) Longitudinal Section of a Worm as Seen by a Linear Probe. Four Echogenic Lines Separated by Three Hypochoic Strips are Shown

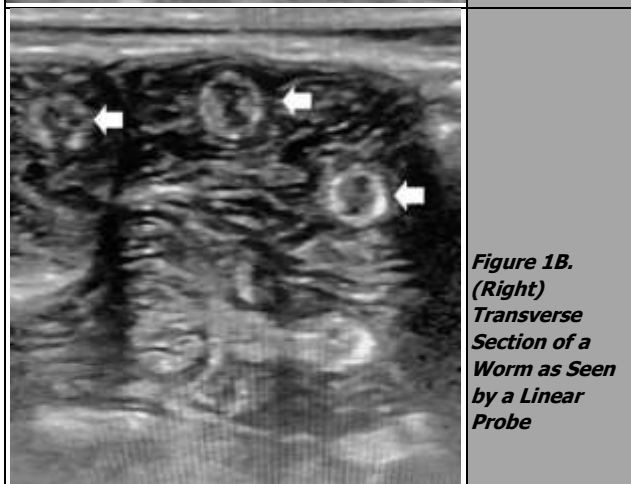


Figure 1B. (Right) Transverse Section of a Worm as Seen by a Linear Probe

The traverse section of the worms appears as small round structures with concentric echogenic opacities with alternating hypochoic areas as shown in Figure 2 B above. This appearance has been variably described as the target sign or the bull's eye sign.⁷

On dynamic scans, with application of gentle pressure with the transducer the worms often show curling movements and a wavy movement that has been associated with peristalsis of the worm.⁸ In our study, we routinely observed the worms for at least 15 seconds during scanning to confirm movement. While living worms in well distended loops of intestine show the characteristic appearance described above, there are certain conditions when the appearance is variable.

If the bowel loops are not distended, often it is difficult to visualise the worms separately. The intestinal walls are present adjacent to the worms giving the appearance of multi-layered echogenic structure often mimicking an intussusception in children.

In patients with features of obstructive jaundice or cholangitis, biliary ascariasis is always differential in endemic areas. Worms in the common bile duct (CBD) may show the characteristic appearance as described above if the CBD is dilated as shown in the Figure 4. However, if the CBD lumen is not dilated or if there are multiple worms producing several overlapping longitudinal interfaces, it may make the diagnosis challenging. This appearance has been called a spaghetti sign and the thickness of the CBD measured as the

distance from the Portal vein has been suggested to be of some help.⁹

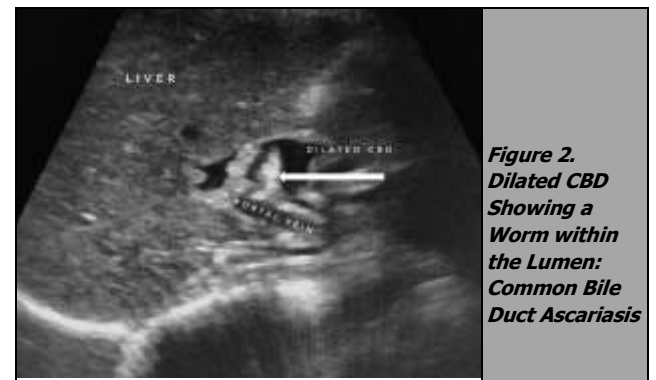


Figure 2. Dilated CBD Showing a Worm within the Lumen: Common Bile Duct Ascariasis

Pancreatitis is a rare presentation often characterised by worms in the Main Pancreatic duct which may very rarely be seen as the appearance is similar to the CBD worms where a tubular structure is seen within the duct often with closely apposed echogenic interfaces as shown in Figure 5. This appearance is often called the "four lines" sign where the four lines are formed by the echogenic duct walls and the worm.¹⁰

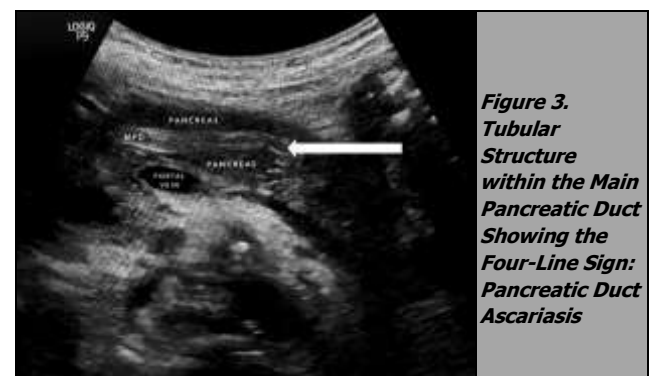


Figure 3. Tubular Structure within the Main Pancreatic Duct Showing the Four-Line Sign: Pancreatic Duct Ascariasis

Worms in the Gall Bladder causing cholecystitis are also quite rare, but if present the worms are often well visualised within the lumen of the gall bladder as a coiled tubular structure with a thick echoic stripe with a thin hypochoic stripe in the middle called the Inner tube sign as shown in Figure 6.¹¹



Figure 4. Coiled Tubular Structure within the Lumen of the Gall Bladder: Gall Bladder Ascariasis

In some of our cases where the patient was under treatment, we found evidence of dead worms and this was

concluded on the basis of three ultrasound findings solid echogenic tubular structures without the typical parallel lines or inner hypoechoic stripe, calcification and no movement on dynamic scans for up to 15 seconds. Worms can die within the hepatobiliary system and can form a nidus leading to formation of stone or sludge. The dead worms can also lead to reactive cholangitis or cholecystitis with obstructive Jaundice. The dead worms are smaller, often shrivelled up, coiled and attached to the lumen wall with features described above as shown in Figure 4 above and identifying these require a high index of suspicion.¹²

The appearance of worms in a patient with Intestinal Obstruction is striking as shown in Figure 8 where the characteristic tubular appearance was seen clearly in distended gut loops and it was often possible to visualise the entire length of the worm.

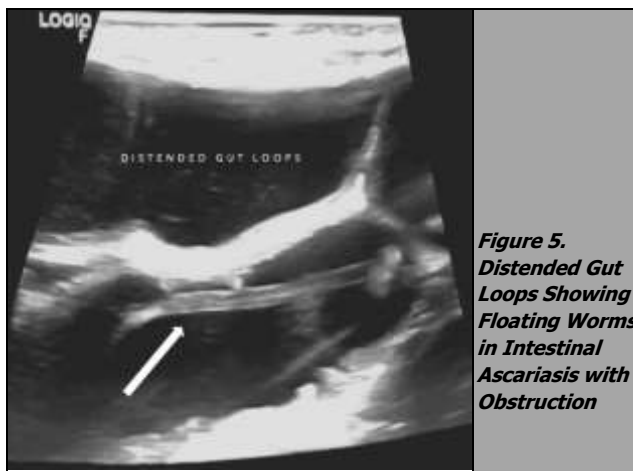


Figure 5.
Distended Gut Loops Showing Floating Worms in Intestinal Ascariasis with Obstruction

Sometimes in these subjects, an "ascaris ball" is seen on ultrasound which appear in transverse section as a cluster of round echogenic ball like structures. Ascariasis have even been reported to cause volvulus of the small intestine.¹³ In cases with high clinical suspicion of worms, if the worms were not visible, we often asked the patient to drink 1 litre of water and repeated the scan. Additionally, we often examined the subjects in left lateral position to remove the gas shadows and enable better visualisation of gut loops, common bile duct as well as the Pancreas. We found that making the patient drink water and scanning in the left lateral position almost always enabled better visualisation of the worms.

While Ultrasound is very effective at the detection of worms, for confirmation we still depend upon stool examination, surgical confirmation or clinical and endoscopic visualisation. The role in which ultrasound excels is early detection of complications of Intestinal ascariasis such as acute intestinal obstruction or appendicitis and those of hepato-biliary ascariasis causing cholecystitis, cholangitis or pancreatitis. Ultrasound is also useful in monitoring post-treatment response by comparing the worm load with previous scans. The presence of dead or calcified degenerated worms raises the possibility of chronic worm infestations in subjects in whom ascariasis is not initially suspected.

It is thus important for radiologists to familiarise themselves with both the characteristic appearance of

worms as well as the appearance affected by the lack of distention or gas shadows in the intestine as well as in less common areas such as the common bile duct, gall bladder and main pancreatic duct. A thorough understanding of the variable appearance of ascariasis will thus be invaluable in including this possibility when constructing a differential diagnosis not only in regions endemic for ascariasis but everywhere in the world, given the extensive global travelling that is seen in today's world.

CONCLUSIONS

The role of ultrasound in the diagnosis of ascariasis is significant as it offers a quick, inexpensive, and very sensitive way to diagnose ascariasis and its complications. In a country like India where it forms a big part of the infectious disease burden, it is important to be aware of the characteristic appearance of ascaris in the intestines and the hepatopancreaticobiliary tree. In addition, it must be remembered that the typical appearance is grossly affected by several factors such as the number of worms, whether the worms are living or dead as well as the luminal distension of the organ housing the parasites.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.

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