Hepatobiliary Ascariasis

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ABSTRACT

Ascariasis, caused by nematode *Ascaris lumbricoides*, is the most common helminthic infection of mankind.1 It is widely prevalent in developing tropical and sub-tropical countries. The infection is acquired by ingestion of embryonated eggs. Although the adult ascaride normally resides in the small intestine, it has been known to migrate to various regions of the body such as lungs, urinary bladder, peritoneum, and biliary system. Worm migration to ectopic sites is influenced by conditions such as fever, drug intake, general anesthesia, and bowel manipulation during surgery. Hepatobiliary ascariasis (HBA) is characterized by migration of the worm into the biliary tree, and accounts for 10-19% of ascaris-related hospital admissions.2,3

EPIDEMIOLOGY AND RISK FACTORS

*Ascaris lumbricoides* affects over one billion people worldwide.4 While ascariasis is most prevalent in the tropical and sub-tropical countries of the developing world, its prevalence in the industrialized nations is increasing as a result of population migration.5,6 The most endemic areas include Africa, the far East, Latin America, south-east Asia, and some parts of the Middle East.7-12 The prevalence rates in China and south-east Asia range from 41-92%.13 In the Indian subcontinent, Ascariasis is highly endemic in Kashmir (70%), Bangladesh (82%) and central and southwest India (20-49%).13

In endemic areas, the prevalence of Ascariasis increases sharply during the first 2 to 3 years of age, remains at a maximum between the ages of 4 and 14 years, and declines in adults.1 However, HBA is more common in adults (mean age 35 years; range 4-70 years) as compared to children, possibly due to the smaller papillary orifice in children.8 HBA affects women more commonly than men (female: male ratio - 3:1).1,9,10,14 Pregnant women are more prone to develop HBA as compared to non-pregnant women.15

Pre-disposing factors for HBA include previous cholecystectomy,16 endoscopic sphincterotomy17 or even prolonged fasting.10 Studies have shown that almost 30% of patients with biliary ascariasis have a prior history of cholecystectomy.16 Dilatation of the common bile duct (CBD) as well as relaxation of the sphincter of Oddi due to a rise in cholecystokinin levels after cholecystectomy...
are the contributory factors for worm migration into the biliary tree. Endoscopic sphincterotomy predisposes to HBA due to widened ampullary orifice allowing easier passage of worms into the ducts.\textsuperscript{18}

**Clinical Presentation**

Most of the *Ascaris* infections are asymptomatic. Patients with heavy worm load are often symptomatic and represent an estimated 1.2 to 2 million cases around the world.\textsuperscript{1} It is estimated that around 20,000 deaths occur every year because of severe disease caused by ascariasis.

**Hepato-biliary**

HBA is one of the most common and well-described entities caused by ascariasis.\textsuperscript{1} In endemic areas, ascariasis has been found to be equal in incidence to gallstones as an etiological factor for adult biliary disease.\textsuperscript{1,9} *Ascaris* reaches the duodenum either because of excessive worm load in jejunum or due to abnormal mobility after intestinal infection with viruses, bacteria or other parasites. Due to its great propensity to explore small openings, ascarides enter the ampullary orifice.\textsuperscript{1,19} It can block the ampullary orifice or can move further into bile duct, hepatic duct or cystic duct. Ascarides have been seen to move actively in and out of the bile duct from the duodenum. Less commonly, the worms can reach the gall bladder or enter the pancreatic duct. *Ascaris* worm or its fragments may act as a nidus around which the stones form.\textsuperscript{8,9,20,21} This process is aided by factors such as bile-stasis and ascending bacterial infection. HBA can have various distinct clinical presentations:

a) **Biliary colic:** It is the most common presenting symptom of HBA with a frequency ranging from 56 to 98\%.*\textsuperscript{8-10} Biliary colic occurs when the worm migrates across the papilla. Patients present with acute pain in the right hypochondrium associated with nausea and vomiting. The pain may be severe, prolonged or recurrent in nature requiring high doses of analgesics.\textsuperscript{1}

b) **Acalculous cholecystitis:** It is another major complication of HBA, accounting for about 10\% of the cases of acute cholecystitis. Patients present with pain in the right hypochondrium, associated with vomiting and low-grade fever. Tenderness and guarding in the right hypochondrium is usually present.\textsuperscript{1}

c) **Ascending cholangitis:** Acute cholangitis may occur in 16 to 25\% as a consequence of persistent biliary obstruction.\textsuperscript{8-10,12} Patients present with right hypochondrial pain, high-grade fever and jaundice. Examination reveals an enlarged tender liver and leucocytosis. Untreated cases may develop hypotension and metabolic acidosis.

Strong epidemiological evidence supports that in endemic areas of ascariasis, recurrent pyogenic cholangitis (RPC) is the aftermath of recurrent biliary invasion by *ascaris*.\textsuperscript{21} RPC and ascariasis have similar geographic distribution. More than 5\% of patients with HBA develop the syndrome of RPC over a 2 year follow-up. In addition, 10\% of patients with RPC have documented evidence of ascariasis, and 72\% of patients with RPC reveal *Ascaris* worm or worm fragments forming nidus for stones.\textsuperscript{1,13} Association between cholangiocarcinoma and biliary ascariasis has been reported infrequently.\textsuperscript{22,23}

d) **Acute pancreatitis:** Acute pancreatitis occurs in 4-36\% of patients with pancreatic-biliary ascariasis.\textsuperscript{8,10,12} It accounts for most of the mortality associated with biliary ascariasis. Patients present with vomiting and epigastric pain radiating to back. Most of the patients (90\%) have mild disease, however, in 10\% cases the pancreatitis is severe. A small group of patients who have massive ascariasis invasion develop haemorrhagic pancreatitis which is associated with high mortality.

e) **Liver abscess:** Liver abscess occurs due to parenchymal invasion by high worm leading to local inflammation, necrosis, and abscess formation. In HBA, liver abscess occurs in less than 1-14.5\% of patients, the frequency being higher in endemic areas.\textsuperscript{8,10} Javid et al described 510 patients with liver abscess in whom 74 (14.5\%) had ascariasis as the source of infection.\textsuperscript{24} Patients present with right upper quadrant pain, fever and tender hepatomegaly.

**Intestinal**

*Ascaris* induced intestinal obstruction is a common complication in children with heavy worm loads in endemic areas, accounting for 5-35\% of the cases of bowel obstruction in these areas.\textsuperscript{13} The most common site of blockage is the terminal ileum. Intussusception, volvulus, haemorrhagic infarction of the bowel, and perforation may occur due to prolonged obstruction.\textsuperscript{2}

Peritonitis may occur if the ascarides enter the peritoneal cavity through the gangrenous bowel wall or through a perforation caused by ulcer due to other etiology. The peritonitis may be fatal; and if the patient
The diagnosis of HPA must be suspected in patients with previous clinical features and to confirm the effect of therapy. Ultrasound examination revealed anechoic areas of the tumor, which were found on the left greater omentum. Ultrasound-guided biopsy was performed, and the results confirmed the diagnosis of HPA.

3. Endoscopic retrograde cholangiopancreatography (ERC)

ERC is one of the essential procedures for diagnosing and confirming the presence of a stricture in the bile duct. ERCP is performed under fluoroscopy, allowing the radiologist to guide the catheter and access the biliary tree. This procedure is essential for the diagnosis of HPA, as it helps to visualize the bile ducts and the presence of any strictures.

4. Laboratory evaluation

Laboratory tests are crucial for the diagnosis of HPA. These tests should include a complete blood count, liver function tests, and serum amylase and lipase levels. An elevated level of serum amylase and lipase can indicate the presence of a bile duct stricture or obstruction. In addition, an imaging study, such as an endoscopic retrograde cholangiopancreatography (ERC), is necessary to confirm the diagnosis.

5. Follow-up

Patients with HPA should undergo regular follow-up visits to monitor the progression of the disease and the effectiveness of the treatment. This includes monitoring liver function tests, serum amylase and lipase levels, and imaging studies. In addition, endoscopic retrograde cholangiopancreatography (ERC) should be performed periodically to assess the efficacy of the treatment and to identify any complications.

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the biliary tree is diagnostic and in those in whom *Ascaris* cannot be demonstrated, visualization of the worms within the duodenum extends supportive evidence of *Ascaris* as the possible etiology behind the biliary-pancreatic disease. The sensitivity of ERCP used alone is 53-58%, while it approaches almost 100% when used in conjunction with real-time sonography. Cholangiograms reveal various abnormalities like dilatation of the CBD or intrahepatic ducts, motile tubular structures within the biliary tree or irregularity and stricturing of the ductal walls. Cholangiographic features of the worms include long, smooth, linear defects; smooth, parallel filling defects; and curves and loops crossing the hepatic ducts transversely. The worm may be seen lying across the papillary opening or an ulcerated or inflamed papilla may provide a circumstantial evidence of the worm’s recent invasion into the biliary tree. Movement of the ascaride out of the biliary tracts coincides with the resolution of symptoms.

Earlier studies have recommended early usage of ERCP, since worm extraction through the papillary orifice can also be accomplished in the same setting. However, the trend of utilizing ERCP as a primary diagnostic tool for biliary ascariasis has evolved whereby it is now utilized mainly for therapeutic purposes. Endoscopic sphincterotomy, balloon extraction of the parasite and bile duct clearance leads to prompt relief of symptoms.

3. Magnetic resonance cholangio-pancreateography (MRCP):

It is an alternative diagnostic tool for ascariasis, which has now become the gold standard method for the diagnosis of biliary diseases, replacing ERCP which is reserved for therapeutic modalities. MRCP can be used to provide more details and subtle information of the biliary tree and it is not operator-dependent. *Ascaris* worms can be seen as hypointense tubular filling defects inside the CBD on MRCP.

4. Computed tomographic (CT) scan does not have any proven accuracy in the diagnosis of biliary ascariasis and is discussed only as case reports. At present, its role remains unclear and needs further evaluation.

5. Barium studies, undertaken incidentally, may add corroborative evidence by showing the intestinal worms.

### B. LABORATORY TESTS

**Biochemical tests**- Variable abnormalities may be seen in liver biochemical tests. Increase in serum alkaline phosphatase is the earliest and most frequent abnormality. Increase in serum amylase can occur depending on the presence or absence of pancreatitis.

**Hematological tests**- Abnormalities include modest neutrophilic leukocytosis, eosinophilia and a rise in serum IgE levels, especially in the migratory phase of *Ascaris*.

**Stool Examination**- Detection of fertilized or unfertilized *Ascaris* eggs (or an adult worm) in the feces is only an indicator of its infestation. However, in the context of a hepatobiliary disease, positive tests help to reinforce the suspicion. The Kato and ocula Miura thick smear is the most effective fecal test, which consists of 30-70 mg of fecal material and has a lot more eggs per female worm than the other smear techniques.

**Serological Tests**- The use of serological techniques in detection of ascariasis is limited because of extensive cross-reactivity between the antigenic epitopes of different nematodes infective to humans. Ascariasis is associated with elevation of IgE and IgG antibodies. These tests provide an indirect indication of *Ascaris* infection and are not specific for biliary disease. Enzyme-linked immunosorbent assay is one of the most sensitive and specific of these tests for detecting specific antibodies. Other tests like radioimmunoassays, agar-gel diffusion and immunoelectrophoretic analysis to detect the presence of IgM antibodies to the *Ascaris* antigen are also available. Problems with serological tests include difficulty in interpretation due to concomitant infections with *Toxocara* or the possibility of heterologous reactions with blood group antibodies, and also the complex antigenic structure of *Ascaris* worm.

**Analysis of bile** obtained through a nasobiliary or percutaneous transhepatic cholangiographic drain can be used to screen for roundworm ova or fragments but this requires the assistance of interventional radiology or endoscopy. This test has a high diagnostic yield and is particularly helpful in cases where the worm has already moved out of the biliary tree.

### MANAGEMENT

1. **Conservative measures**

Most of the cases of HBA (42-90%) can be treated with conservative measures and endoscopic worm extraction.
may not be indicated as the Ascaris may move out of the biliary tree spontaneously.\textsuperscript{8,9,16,38} Conservative measures include bowel rest, intravenous fluid therapy, analgesics, antibiotics, and antispasmodics. Conservative treatment is continued usually for 3 days and patient is monitored for improvement in symptoms. During this period migration of the worm should be monitored by serial ultrasonography. Targeted vermifuge against A. lumbricoides should be delayed until the worms move out of the biliary tree.

2. Endoscopic Management

The use of endoscopic intervention for HBA had brought about a major reduction in the morbidity and mortality of this disease.\textsuperscript{12,29,34,38-44} However, endoscopic intervention /ERCP should be considered only if a patient fails to respond to conservative treatment; or the worm persists (as demonstrated by serial ultrasonography) or has died within the pancreatic-biliary tree.\textsuperscript{45} Presence of coexistent strictures or stones within the ducts are also indications for ERCP. Khuroo et al showed that ERCP/endoscopic intervention was only required in 29% of patients who failed to improve with conservative management.\textsuperscript{38} Indications of early ERCP include patients presenting with pyogenic cholangitis and acute pancreatitis. Maximum utility of endoscopic intervention is derived when the procedure is undertaken in a symptomatic patient.\textsuperscript{9,29} Grasping of the worm by a Dormia basket and extracting it through the papilla leads to a rapid relief of symptoms and a reduction in complication rate.\textsuperscript{12,24,34,39} Sphincterotomy should be avoided if possible and worm extraction attempted by balloon to avoid possible future re-invasions. ERCP has a success rate of up to 90% for worm-extraction.\textsuperscript{1} Infrequent complications of the procedure include fragmentation or incomplete extraction of the worm causing sclerosing strictures of the ducts. In cases where the worm cannot be removed, nasobiliary drainage and supportive treatment with analgesics, antispasmodics and antibiotics can still accomplish biliary decompression.

Location of parasite within the intrahepatic ducts\textsuperscript{14,38} or presence of dead and calcified worms, which get impacted, lead to difficulty in extraction. Worms within the pancreatic duct are also not amenable to easy endoscopic extraction and therefore, these patients carry a poor prognosis.\textsuperscript{29} ‘Whirlpool jet technique’, which includes injecting a jet of contrast material into the pancreatic duct to flush the roundworm out following which it can be grasped by a basket and then extracted has been described.\textsuperscript{46}

3. Drug therapy

Drugs effective against A. lumbricoides include albendazole, mebendazole and pyrantel pamoate.\textsuperscript{47} Asymptomatic colonization with A. lumbricoides is treated easily with a single 400-mg oral dose of albendazole. Parasite immobilization and death of the helminthe are slow and complete clearance of the worm from the gastro-intestinal tract may take up to 3 days. Efficacy of the treatment can be determined by stool examination 1-2 weeks after treatment. However, negative stool samples do not necessarily indicate eradication of the roundworm.

Patients with hepatobiliary ascariasis should be treated with albendazole each day for several days because the worms only become susceptible when they migrate out of the bile duct.\textsuperscript{38} Due to the lack of enterohepatic circulation of albendazole, there is no evident activity of this drug against the worms when they invade the biliary tree.\textsuperscript{47,48} This feature of albendazole is in fact advantageous because if the worms were paralyzed in the biliary tree, they would be unable to pass through the sphincter of Oddi and get trapped in the bile duct.

Direct instillation of the antihelmintic agent into the biliary tree is not recommended. The resultant flaccid paralysis of a worm within the biliary tree eventually leads to its death within the ducts. The macerated worm then elicits a severe inflammatory reaction eventually leading to fibrotic strictures.

Treatment with anti-helminthics has not been shown to be effective in preventing the recurrence of ascariasis, as there is a high rate of re-infection in endemic areas. Even once-monthly courses of anti-helminthics have shown to be ineffective in preventing relapses.\textsuperscript{8} Moreover, long term administration of these drugs may lead to complications.

4. Surgical therapy

With the advent of ERCP for management of hepatobiliary diseases, surgery is now rarely required for treatment of HBA. Less than 1% of HBA cases which are not amenable to endoscopic extraction may need to undergo surgery.\textsuperscript{10,34,38} Other indications include presence of hepatic-ductal or gallbladder ascarides and acute pancreatitis. Some of the surgical methods employed in the management of intractable biliary ascariasis include choledochotomy, choledochoduodenostomy and intra-operative biliary duct syringing to increase the hydrostatic
pressure and facilitate worm expulsion.

Hepato-jejunostomy may be required for intractable stricturing disease of the biliary ducts, and lobectomy for strictures localized to one lobe of the liver. Flush therapy with normal saline injected through a T-tube has been effectively used to manage post-operative biliary ascariasis.  

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