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Review

Human schistosomiasis: A diagnostic imaging focused review of a neglected disease☆

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Abstract

Schistosomiasis is one of the major tropical and sub-tropical diseases caused by trematodal parasite of genus *Schistosoma*. This neglected disease affects 200 million people, resulting in the loss of 1.53 million disability-adjusted life years (DALY). The disease presents in wide spectrum including both acute and chronic forms, affecting multiple target organs. The schistosomal infection is mainly diagnosed by demonstrating evidence of infestation by parasitological, serological or molecular methods using samples such as stool, urine, blood or other body fluids and tissue specimens. However, these test methods have their own limitations in evaluating severity of morbidity. The role of diagnostic imaging modalities such as ultrasonography, CT scan and MR scan is crucial not only to diagnose the disease but also to evaluate the severity of the disease process and its complications in target organs. The clinical and imaging features of the disease can mimic other infectious as well as noninfectious disease. Thus, it is essential to be familiar for radiologists and physicians with the imaging features of schistosomiasis, so as to make accurate and timely diagnosis and thereby, reducing the morbidity and mortality of this disease. Ultrasound is considered as primary modality of choice as it is able to pick characteristic hepatosplenic and urinary lesions. Typical ultrasonographic findings of hepatosplenic schistosomiasis include periportal fibrosis, hypertrophy of the left liver lobe, atrophy of right liver lobe, splenomegaly, and ascites. CT and MR scan are valuable not only for hepatosplenic and urogenital schistosomiasis, but also for secondary and ectopic lesions such as those in CNS and lungs, which are difficult to be assessed by ultrasonography. Periportal fibrosis, map-like calcification of liver parenchyma, nodular enhancement of the cerebral mass are some typical imaging findings of schistosomiasis.

Keywords: Schistosomiasis; Ultrasonography; CT scan; MR scan

1. Introduction

Schistosomiasis is a common tropical infectious disease distributed mainly across Africa, Asia and South America. Globally, it affects 74 countries and continues to spread in newer geographical areas despite new treatment and control measures [1]. The disease is caused by trematodal parasite of genus *Schistosoma* and ranks third among major tropical diseases after malaria and intestinal helminths [2]. Among twenty five total known species, there are only five infected human.

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They are *Schistosoma mansoni, Schistosoma japonicum, Schistosoma haematobium, Schistosoma mekongi, and Schistosoma intercalatum*. Among them, *Schistosoma mansoni, Schistosoma japonicum, Schistosoma haematobium* are the major disease causing parasites in human globally. This neglected disease affects 200 million people, resulting in the loss of 1.53 million disability-adjusted life years (DALY) [3]. Familiarity with the imaging features is essential for prompting and confident diagnosis of schistosomiasis and evaluating the severity of mobidity. In this review, we describe imaging features of different forms of diseases in various target organs on the background of pathogenesis.

2. Life cycle and pathogenesis

All human schistosomes undergo similar lifecycle [1,4]. The parasite has separate sexes. The longer and thinner female worm resides in the gynecophoric channel of male. Human is the primary host where sexual cycle occurs, and the fresh water snail is the intermediate host where asexual cycle takes place. Only certain species of snails belonging to genus *Biomphalaria* (*S. mansoni*), *Bulinus* (*S. haematobium*) or *Oncomelania* (*S. japonicum*) can transmit the schistosome species [5]. The female produce numerous eggs, each egg contains a miracidium larva. The miracidium larva is ciliated and secretes proteolytic enzymes which help the eggs to migrate to intestine or urinary bladder. The eggs are excreted via feces or urine. When in contact with water, each egg releases a miracidium larva. The miracidium swims with the help of cilia and finds a freshwater snail, the intermediate host, and penetrates it developing asexually in to secondary larvae, called cercaria. These cercarial larvae are shed in hundreds from the snail, under stimulation of light. The cercarial larvae has large head with embryonic feature of adult worm and has bifurcated tail. These larvae whirl around in water and penetrate the dermis of the human skin when comes in to contact. During penetration into the human skin, they shed off their tail and migrate via bloodstream to the heart, then to the lungs, the liver and the portal vein where they mature in weeks. The adult worms mate and finally migrate upstream to their final destination of mesenteric veins where the cycle starts all over again.

3. Spectrum of clinical morbidity

3.1. Acute schistosomiasis

Swimmers itch occurs as the cercarial larvae penetrate the human skin. It manifests as local urticarial reaction usually lasting for few hours. However, this reaction may prolong for days resulting in maculopapular eruptions in skin. Bronchopneumonia occurs due to bronchial hypersensitivity to schistosomulae migrating through pulmonary capillaries [8]. This presents with pulmonary infiltrates on radiography. A few weeks (1–4 weeks) after the skin penetration, the developing schistosomula causes delayed systemic hypersensitivity reaction, manifested by features of serum sickness like syndrome i.e. fever, malaise, fatigue, headache, chills, non-productive cough, and abdominal cramping. This acute form of schistosomiasis is also known as Katayama syndrome. This syndrome coincides with the stage of worm maturity and can rapidly progress to hepatic fibrosis, portal hypertension and splenomegaly [1,6].

3.2. Chronic schistosomiasis

The eggs deposited in the target organ provoke granulomatous reaction. This results to deposition of the fibrotic materials causing significant pathological changes in the affected organs. This is the chronic form of disease. *Schistosoma haematobium* preferably infects urinary bladder whereas *Schistosoma mansoni*, *Schistosoma mansoni*, *Schistosoma intercalatum* and *Schistosoma mekongi* infect the distal colon and the rectum. These are the sites via which the parasite can expel its ova to the external environment and thus are the primary targets. The secondary targets, upper urinary tract and liver, are involved as a result of spill overdue to various mechanisms like obstruction or reflux at vesico-ureteric junction and drifting of ova through portal vein stream. The lung is also a secondary target as ova find their way to pulmonary circulation via normal portosystemic anastomoses. Occasionally, ova infect the ectopic target organs like brain, spinal cord, genitals, eyes, skin, through their respective venous anastomoses with inferior vena cava.

3.2.1. Urinary schistosomiasis

Schistosoma haematobium infects the lower urinary tract i.e. lower ureters, urinary bladder, seminal vesicles and occasionally vas deferens, prostate and female genital organs. The eggs which get trapped in the wall of urinary bladder provoke granulomatous inflammation resulting in the formation of nodules, tubercles, micro or macro polyps or masses which often undergo ulceration, fibrosis and calcification. The disease commonly affects children in endemic areas. They typically present with microscopic or frank hematuria and frequent painful micturition. Secondary bacterial infection and stones can exacerbate these symptoms [1,3]. The disease may affect the general well-being resulting in reduced productivity and school performance of children [7]. In adults, hematuria disappears and the disease evolves into fibrosis, calcification, hydroureter, hydronephrosis and eventually renal failure. Chronic urinary schistosomiasis is also associated with squamous cell carcinoma of urinary bladder [8].

3.2.2. Intestinal schistosomiasis

Large bowel and rectum are mainly infected by *Schistosoma mansoni* or *S japonicum*. The eggs of parasite get trapped in the wall of mesentery and provoke the granulomatous inflammatory reaction causing micr-ulceration, pseudopolyps and bleeding. The disease may remain asymptomatic or present with non-specific symptoms of abdominal pain, anorexia, diarrhea or dysentery. However, this chronic condition can have significant impact on general health among children [7].