Sonographic early findings in a case of bladder schistosomiasis

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Abstract

Urinary schistosomiasis is a tropical infection with a high endemicity in the developing countries and is included in the list of “Neglected Tropical Diseases”. It is caused by a parasitic worm, *Schistosoma haematobium*, and it has come into the spotlight as a major cause of urogenital disease. Furthermore, it is linked to bladder cancer and it is a predisposing factor for HIV/AIDS. In this case, we describe a bladder schistosomal disease in a young African boy with persistent macroscopic hematuria and its ultrasound diagnostic bladder imaging.

Keywords *Schistosoma haematobium* · Bladder · Ultrasound · Pseudopolyp mass

Sommario

La schistosomiasi urinaria è un’infezione tropicale endemica nei paesi in via di sviluppo, inclusa nell’elenco delle “Malattie Tropicali Neglette”. E’ causata da un parassita, lo *Schistosoma Haematobium* e si annovera tra le cause maggiori di malattia urogenitale. Si correla inoltre al cancro della vescica e rappresenta un fattore predisponente per l’infezione da HIV/AIDS. Descriviamo un caso di schistosomiasi vescicale in un giovane ragazzo africano con ematuria macroscopica persistente illustrandone gli aspetti all’imaging ecografico.

Introduction

Schistosomiasis is one of the major infectious diseases affecting developing countries. It affects about 200 million people, but probably less than 5% of these have an important clinical schistosomal disease [1]. Schistosomiasis (bilharzia) is caused by a parasitic worm [2]. The infection is contracted by simple exposure to fresh water containing helminth cercariae shed by infected snails. The cercariae penetrates the skin, migrates intravascularly to the liver and later lays eggs in the mesenteric (*Schistosoma mansoni* and *Schistosoma*

japonicum) or urogenital (*Schistosoma haematobium*) venules. *Schistosoma haematobium* has come into the spotlight as a major cause of urogenital disease and as an agent linked to bladder cancer [3] and a predisposing factor for HIV/AIDS [4]. In the urinary tract, it mainly affects the lower ureters, leading to obstruction with renal failure, and the bladder, causing cystitis. The worms dwell in the blood vessels and release eggs that become embedded in the bladder wall to elicit chronic immune-mediated disease [5] and induce squamous cell carcinoma [6]. Ultrasound study is considered a valuable tool to assess the urinary system, pathology and complications associated with schistosomiasis, as well as the therapy’s follow-up [7, 8]. Here, we describe the case of a bladder schistosomal disease in a young African boy with persistent macroscopic hematuria and the associated ultrasound diagnostic bladder imaging.

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Case report

A 12-year-old male, a Ghanaian national, came to our observation with a story of a 1-month terminal, intermittent, macroscopic hematuria associated with irritative urinary symptoms, empirically treated as a lower urinary tract infection due to *Enterobacter cloacae*. The physical examination was unremarkable, without any alterations in the blood test. The urine sediment was observed to be > 100 RBCs by the field. Three urine cultures were sterile. An abdominal ultrasonography was performed with a convex probe (3–5 MHz—Esaote MyLab Twice) and it revealed the normal appearance of the kidneys, while significant alterations were detectable in the bladder. The bladder was studied with orthogonal transverse, longitudinal and oblique scans, as well. The images displayed a modest and diffuse thickening of the walls, associated with irregularities of the mucous profile with focal pseudopolypoid sessile thickening with a base ranging from a few millimeters up to a 2.5-cm variable plant (Fig. 1). These pseudopolypoid lesions appeared tensely adhering to the bladder wall, immobile to the patient's decubitus changes and diffusely hyperechogenic, but without “shadows” to differentiate them from endoluminal calculi (Fig. 2). The color Doppler study showed the presence of increased vascularization, notably within the pseudopolypoid lesions (Fig. 3). These bladder ultrasound findings in the young boy with hematuria who comes from an African area with endemic schistosomiasis lead us to hypothesize a bladder schistosomal disease in an acute phase. The cytological examination of the urine revealed the presence of the *Schistosoma haematobium* eggs, characterized by an “end

Fig. 2 Frankly hyperechogenic pseudopolypoid lesions without “shadows” (arrows)

plug” (Fig. 4), which confirmed the hypothesis and made a diagnosis, along with positive serological testing for schistosomiasis. The patient underwent a cystoscopic transurethral resection of the bladder lesions with a histologic finding, confirming the diagnosis and began a medical treatment with Praziquantel. After 3 months, the patient was asymptomatic with normal urine analysis, cytology and ultrasonography.

Fig. 1 Longitudinal transabdominal ultrasound shows mucosal irregularity with bladder pseudopolyp granularomas on the base (arrows)

Fig. 3 Longitudinal transabdominal color Doppler ultrasound shows the presence of increased vascularization in the pseudopolyp granularomatosis wall area (arrows)

Fig. 4 Urine cytology, in which can be observed *Schistosoma haematobium* eggs with their typical terminal spines (arrow)

Discussion

Estimated 207 million cases of human schistosomiasis have been reported worldwide, and about 90% of these live in Sub-Saharan Africa [9]. It affects both men and women, with an incidence that reaches its peak in teenagers, aged between 11 and 15 years [10] and a subsequent decline by age 65 [9, 11]. It is caused by the blood fluke of *Schistosoma haematobium*. The disease is widely diffused in areas in which there are large bodies of water for irrigation, particularly where dams have been constructed. A prevalence rate of 12.4% has been reported in some endemic regions in Ghana [12]. Several species of *Schistosoma* have been detected and classified among others: *S. mansoni*, *S. japonicum*, *S. mekongi*, *S. eagle*, *S. haematobium*, *S. intercalatum*, and *S. mattheii*. *S. haematobium* is the only known *Schistosoma* to produce urinary effects; the remaining species cause gastro-intestinal tract manifestations [10].

Schistosoma haematobium worms enter the human host by penetrating the skin. They are then carried via the portal venous system to the liver, where they mature into their adult form. Then, adult forms of *Schistosoma* most likely enter the peri-vesical venous plexus by the hemorrhoidal plexus. The female worms then deposit eggs into the venules of the bladder wall and ureter [13], which is why related pathology is found mainly in the urinary bladder, ureters and kidneys [7]. The deposition of *Schistosoma* eggs in the bladder sub-mucosa provokes the formation of granulomas and their subsequent coalescence leads to the formation of pseudotubercles, which appear as seed-like bodies surrounded by a zone of hyperemia. A congregation of the tubercles, the mucosa hyperplasia and the bladder wall muscle hypertrophy result in nodular or polypoid lesions that tend to ulcerate and

bleed, as in this case. The most common late lesion is the “sandy patch” where calcified ova appear like sand beneath the atrophic mucosa. The bladder mucosa loses its pink appearance, the subepithelial branching of blood vessels is not visible and the picture is described as “the ground glass” mucosa [14]. Pseudotubercles and all changes previously described may also be present in the walls of the ureters [15]. When pseudotubercles’ development in the ureter and bladder occurs, the urothelium thickens. Over time, the pseudotubercles calcify, and the calcification may be fine, granular and linear, or thick and irregular. If repeated infections occur, the urinary bladder will become small and fibrotic. Bladder stasis results in an increased incidence of ureteral and bladder calculi. Patients with chronic disease also have an increased incidence of squamous cell carcinoma [13]. Urinary schistosomiasis can have a devastating impact on the urinary tract and the whole kidney. If not detected early and cured promptly, Schistosomiasis could be fatal [11]. The main features of urinary schistosomiasis are painful terminal hematuria, loin pain, and symptoms of secondary bacterial infection. Symptoms associated with genital schistosomiasis are dysmenorrhea, menorrhagia, leucorrhea, lower abdominal pain and intermenstrual bleeding. Some patients present, along with signs and symptoms of microscopic hematuria, pain in the left lumbar and abdominal regions [15]. Schistosomal “contracted bladder” syndrome, consisting of deep lower abdominal and pelvic pain, urgency and incontinence, is observed most frequently during the late stages when the load active chronic stage eggs proliferate more [10]. Urinary retention only occurs when large polypoid masses are present [16]. The diagnosis is based on parasitology and serology. Despite lacking specificity, proteinuria and parasite egg count are the best methods to predict bladder pathology [7]. Ultrasound study is considered a valuable tool to assess urinary system pathology associated with schistosomiasis [8]. It is safe, rapid, non-invasive, acceptable and applicable in field settings, and it enables the examination of a large number of people at a relatively low cost per capita [17]. The ultrasound appearance of acute cases is similar to that of bacterial cystitis [2], with which it must be placed in differential diagnoses. Bladder wall thickening is regarded as a characteristic of schistosomal cystitis [16]. The initial involvement is characterized by bladder lesions with a typical sonographic appearance consisting of homogeneous and wave-like bladder wall enlargements, in combination with polypoid vascularized mucosal lesions and a uniform echotexture protruding into the bladder lumen, as in our case (Table 1). Some authors named them “acute giant bilharzial granulomas” [16] which can be used for different diagnoses with a tumoral formation if we consider young patients with urinary symptoms and a history of immigration, or travel across, areas known to be endemic, as in our case report. In the early cases, the wall is non-calcified, as in our

Table 1 Bladder US features in acute and chronic phase of schistosomiasis

Bladder US features	
Acute phase	Homogeneous and wave-like bladder wall enlargements Focal pseudopolypoid lesions Increased vascularization
Chronic phase	Thickening increase of the bladder wall Linear or punctuate calcifications in the bladder wall that appear as echogenic foci casting “shadows” Endoluminal calculi Calcified bladder or “porcelain bladder”

case. In chronic cases, there are usually linear or punctuate pathognomonic calcifications, appearing as echogenic foci casting shadows [2] which differ from echogenic foci in an ultrasound, with ring-down shadowing due to infection by gas-forming organisms of emphysematous cystitis. Calcifications in urinary schistosomiasis are caused by dead ova in the tissue, which accumulates calcium, rather than by calcification of the tissue itself. They are a late manifestation of urinary schistosomiasis [18]. Ultrasonography is more sensitive in detecting the initial, small calcifications than are the conventional radiological methods [16]. The classic presentation of calcified bladder or “porcelain bladder” means that it is too late for the conventional radiography, and is pathognomonic of chronic end-stage urinary schistosomiasis. Ultrasound can also provide direct information about lesions in the other internal organs [7], even if the kidneys are normal until late in the disease [13]. Ultrasound has been proven to be an important means to evaluate the lesion extent of the urinary tract, such as dilation of the renal pelvis and bladder wall lesions [7]. By the time that the bladder wall is thickened, the structural abnormalities can be found mostly in the trigonal area and the base [18]; the lower ureters are almost invariably structured by the hydronephroses [2] as well as documented with the ultrasound. There are often calculi in the bladder [2] which look like mobile echogenic foci within the bladder on ultrasound. Hydroureter, hydronephrosis, non-functioning kidneys, ureteral, bladder stenosis, and ureteral filling defects such as polypoid lesions are also well observed in a standard urogram, Computed Tomography Urography or Magnetic-Resonance Urography. Cystography shows the possible reduction of bladder capacity or appearance of repletion defects, which must be further assessed by the cystoscopy [10]. Endoscopic studies allow the display of injuries directly and biopsies of the same. Granulomas, erosions and mucosal congestion are typical of the early stages of the disease, while secondary injuries are represented by the bilharzia nodules which appear in the tertiary stage. Later in the disease, nodules (with ova) and ulcers are seen; finally, “sandy” patches (fibrotic areas)

develop. Inflammatory polypoid erythematous lesions are mostly found on the dome and lateral walls of the bladder. An important feature of bladder schistosomiasis is the coexistence of injuries in different evolutionary stages [10]. The definitive diagnosis is given by serological testing for schistosomiasis and the presence of *Schistosoma* granulomas and eggs in bladder biopsies [10].

Conclusions

Schistosomiasis is one of the main tropical diseases; thus, it is considered necessary to perform urinary and parasitological analysis in subjects with urinary symptoms and a history of immigration, or travel across areas known to be endemic, like the boy in our case report, to detect numerous cases of bladder schistosomiasis which would otherwise go unnoticed. Given the high prevalence of schistosomiasis in the sub-Saharan countries and the clinical, epidemiologic implications, the appearance of macro- or microscopic hematuria or any other urinary symptoms in people coming from those risk areas requires a complete evaluation and at least a parasitological analysis [10]. Bladder polyps due to schistosomiasis represent an increasingly common condition in our countries and must be considered in the case of any intense unexplained urinary inflammation combined with a history of immigration from, or stay in, or travel across, areas known to be endemic for this helminthiasis, as in our case [11]. Ultrasound study is considered a valuable tool to assess the urinary system, pathology and complications associated with schistosomiasis [8]. Ultrasonography is the only technique that is feasible and present for field use to assess the disease impact in terms of damage to the organs, the regression of lesions after treatment, and the resurgence of pathological lesions due to reinfection [17], so it has become an invaluable extension of the clinical investigation of patients with schistosomiasis and has provided direct evidence of the pathologic changes associated with this infection [19]. Concerning *S. haematobium*, ultrasound is mainly used for detecting urinary system and pathology complications, as well as therapy’s follow-up [7, 8]. In our case, ultrasound has helped to detect the early pseudopolypoid changes in the bladder wall even before pathognomonic wall calcifications. In our opinion, the knowledge of the early structural changes in the bladder wall due to this parasitic infection allows for a rapid diagnosis and makes a different diagnosis from lithiasis aggregates and from tumoral formation.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

References

- Cheever AW (1968) A quantitative post mortem study of schistosomiasis mansoni in man. *Am J Trop Med Hyg* 17:38–64
- World Health Organization (2011) Urinary bladder, urethra, prostate and seminal vesicles and penis. In: Lutz H, Buscarini E (eds) WHO manual of diagnostic ultrasound, vol 1, 2nd edn
- Rollinson D (2009) A wake-up call for urinary schistosomiasis: reconciling research effort with public health importance. *Parasitology* 136:1593–1610
- Hotez PJ, Fenwick A, Kjetland EF (2009) Africa's 32 cents solution for HIV/AIDS. *PLoS Negl Trop Dis* 3:e430
- Gryseels B, Polman K, Clerinx J, Kestens L (2006) Human schistosomiasis. *Lancet* 368:1106–1118
- Palumbo E (2007) Association between schistosomiasis and cancer: a review. *Infect Dis Clin Pract* 15:145–148
- Elmadani AE, Hamdoun AO, Monis A, Karamino NE, Gasmelseed N (2013) Ultrasound findings in urinary Schistosomiasis infection in school children in the Gezira State Central Sudan. *Saudi J Kidney Dis Transpl* 24(1):162–167
- Cairo Working Group. Edited by Jenkins JM, Hatz C (1992) The use of diagnostic ultrasound in schistosomiasis—attempts at standardization of methodology. *Acta Trop* 51:45–63
- Onile OS, Awobode HO, Oladele VS, Agunloye AM, Anumudu CI (2016) Detection of urinary tract pathology in some *Schistosoma haematobium* infected Nigerian adults. *J Trop Med.* <https://doi.org/10.1155/2016/5405207>
- Maestro MA, Gonzalez ER, Garcia PD, Herrador JV, Rodriguez JD, Martinez-Piñero L (2010) Bladder schistosomiasis: case report and bibliographic review. *Arch Esp Urol* 63(7):554–558
- Rambau PF, Chalya PL, Jackson K (2013) Schistosomiasis and urinary bladder cancer in North Western Tanzania: a retrospective review of 185 patients. *Infect Agents Cancer* 8(19)
- Antwi S, Aboah KEK, Sarpong CKG (2014) The unacknowledged impact of urinary schistosomiasis in children: 5 cases from Kumasi, Ghana. *Ghana Med J* 48(4)
- Tublin M, Thurston W, Wilson S (2011) The kidney and urinary tract: parasitic infections. In: Rumack C et al Diagnostic ultrasound, 4th edn. Elsevier Volume one Part II Chapter
- Webbe G, Infection with *S. haematobium* (1982) In: Jordan P, Webbe G (eds) Schistosomiasis: epidemiology, treatment and control, 1st edn. Pitman Press, London
- Tzanetou K, Adamis G, Andipa E, Zorzos C, Ntoumas K, Armenis K, Kontogeorgos G, Malamou-Lada E, Gargalianos P (2007) Urinary tract *Schistosoma haematobium* infection: a case report. *J Travel Med* 14:334–337
- Dittricht M, Doebling E (1986) Ultrasonographical aspects of urinary schistosomiasis: assessment of morphological lesions in the upper and lower urinary tract. *Pediatr Radiol* 16:225–230
- Hatz C, Jenkins JM, Morrow RH, Tanner M (1992) Ultrasound in schistosomiasis—a critical look at methodological issues and potential applications. *Acta Trop* 51:89–97
- López López AI, Cao Avellaneda E, Prieto González A, Ferri Níguez B, Maluff Torres A, Pérez Albacete M (2007) Esquistosomiasis: una parasitosis urinaria cada vez más frecuente. *Actas Urol Esp* 31(8):915–918
- Brouwer K, Munatsi A, Ndhlovu PD, Wagatsuma Y, Shiff CJ (2004) Urinary schistosomiasis in Zimbabwean school children: predictors of morbidity. *Afr Health Sci* 4:115–118