

Original Article

MANAGEMENT OF BILHARZIASIS OF THE CONUS MEDULLARIS

Karam Kenawy<sup>1</sup>, Abdin K Kasim<sup>1(\*)</sup>, Nahla Mahmoud<sup>2</sup>, Mahmoud Saif-Al-Islam<sup>3</sup>,  
Khalid Naser<sup>1</sup>

<sup>1</sup>Neurosurgery dept., <sup>2</sup>Radiology dept., <sup>3</sup>Tropical Medicine and Gastroenterology dept., Sohag  
University Hospitals, Faculty of Medicine, Sohag Univ., Sohag, Egypt.

\*E-mail: [abdin\\_mail@yahoo.com](mailto:abdin_mail@yahoo.com)

Received 13/6/2021

Accepted 24/10/2021

**Abstract**

*Schistosomiasis is one of the most prevalent tropical diseases in the world. Spinal cord neuroschistosomiasis is an uncommon complication mainly due to infestation by Schistosoma mansoni and may be caused by Schistosoma haematobium. Diagnosis depends on detection of anti-bilharzial antibodies and MRI of lumbar spine. The main treatment is medical. Surgery is an option for resistant cases. From January 2009 to January 2020, we reviewed patients with conus medullaris bilharziasis, who received different modalities of management. Clinical presentation, treatment plans, outcomes, and complications were reported. We studied 21 patients with conus bilharziasis. Males constituted 95.2 % and the age ranged from 8-12 years with a mean of 9.8 years. Low back pain and hypoesthesia were present in 100 % of patients while retention of urine in 95.2%. Examination of urine for S. haematobium ova was negative in 100 %, while stool examination for S. mansoni ova was positive in 4.8%. Mild to moderate expansion of the distal spinal cord and conus medullaris was seen in 100 % of MR images. After medical treatment; complete improvement was achieved in 71.4%, and partial improvement in 9.5%. Surgery was done in 19 % after failure of medical treatment and physiotherapy of whom, 4.8 % improved completely, 4.8 % improved partially while no improvement occurred in 9.5%. Conus lesions in endemic areas should trigger the possibility of Bilharziasis. Early diagnosis by MRI and positive anti-bilharzial antibodies is essential for management to avoid complications.*

**Keywords:** Bilharziasis, Conus medullaris, Low back pain.

**1. Introduction**

Schistosomiasis is a parasitic infestation caused by blood flukes schistosoma of genus trematodes that mainly affects the liver, intestine and urinary system. Theodore Bilharz, a German surgeon who worked in Egypt, was the first to identify the parasite in 1852, hence the other name is Bilharziasis [1]. The tropical regions of Africa, South America and Asia, are the main parts affected in the world with the former being the worst [2]. About 200 million people are infected worldwide as estimated by the World Health Organiza-

tion. People living near rivers are particularly at risk. Also, population migration and travelling may lead to spread of the disease in non-endemic areas [3]. Neuroschistosomiasis, which refers to schistosomal involvement of the central nervous system (CNS), is an uncommon, but recognized complication of Schistosomiasis [4]. Spinal cord neuroschistosomiasis is mainly due to infection by S. mansoni and may also be caused by S. haematobium. It is more common in young adults, teenagers, and children, which is likely

due to the frequent exposure of male gender [5,6]. Professor El-Banhawy, was the first to diagnose and treat Bilharzial granuloma of the conus medullaris and cauda equina in Egypt [7]. The mechanism of egg deposition in spinal cord is unknown. It is believed that the eggs reach the CNS via retrograde venous flow into the Batson vertebral epidural venous plexus, which connects the portal venous system and venae cavae to the veins of brain and spinal cord [8]. Once the eggs are deposited in the nervous system, they trigger an acute form of immune complex reaction and a chronic form of cell-mediated immune granulomatous reaction [9]. The mature larvae secrete immunogenic and antigenic substances, resulting in an inflammatory reaction that varies, from a very little reaction to intense granulomatous reaction according to the status of the host immune system [6,8]. Central nervous system schistosomiasis has been described in soldiers and workers serving in areas where schistosomiasis is endemic [2,10]. Spinal cord neuroschistosomiasis is more common in young adults, teenagers, and children (mostly males), which is likely due to the frequent exposure of male gender in rural areas [5-7]. The onset of symptoms is usually acute or subacute. The time between the onset of manifestations and the development of the full neurological picture is about 15 days or less in approximately 70% of cases. Patients with spinal cord disease usually present with low back pain, lower limb radicular pain, motor weakness, sensory loss and incontinence. The most common primary complaint is low back pain observed in 79-100% of individuals [11, 12]. Stool examination reveals *S. mansoni* ova in about 40% of cases. Biopsy from rectum has a higher sensitivity in cases of *S. mansoni* allowing the identification of the eggs in 95-100% of the cases. Detection of Bilharzial antibodies in the serum is simple, fast and reliable test for detection of neuroschistosomiasis. However, in the presence of the right clinical picture

with MRI features and excluding other causes of transverse myelitis, one feels there is enough supportive circumstantial evidence to justify the start of empirical medical therapy without delay [11,13,14]. There is no universal agreement regarding therapy of neuroschistosomiasis. Medical therapy, corticosteroids, and surgery have all been used. Praziquantel is a broad-spectrum antibilharzial drug, resulting in a parasitological cure in 70-90% of patients [15].

## **2. Patients and Methods**

This is a retrospective study done during the period from July 2009 to January 2020. Informed consent was obtained from the parents or the legal patient's guardian. This study included 21 patients with conus medullaris. Inclusion criteria: Any patient presenting with conus medullaris lesions with positive anti-bilharzial antibodies. Exclusion criteria: Cases with bad general conditions or negative bilharzial antibodies. All patients were hospitalized and subjected to: Full medical history taking and clinical examination. Neurological examination was done to detect low back pain, unilateral paresis or paraparesis, saddle hypoesthesia or urinary disturbances mainly retention.

### **2.1. Preoperative investigations**

The following investigations were done:

- 1) Complete blood count.
- 2) Urine and stool examination for schistosoma infestation.
- 3) Detection of serum anti-bilharzial antibodies.

All patients underwent MR imaging of the dorso-lumbar spine with and without contrast.

### **2.2. Treatment plan**

All cases were treated by medical treatment in the form of: Intravenous methyl prednisolone (1 g/day, for 3 days), followed by dexamethasone for 12 days. Praziquantel (one single oral dose of 50 mg/kg), repeated after one week. Prednisolone (1 mg/kg/day, for one month).

Physiotherapy was applied if there is neurological deficit. The patients were followed up by clinical evaluation, stool and urine analysis, anti-bilharzial antibodies tests and radiologically by MRI performed 1 month and one year after treatment. Surgical treatment was done in cases of failure of medical treatment. Complete or partial excision of the mass was done to decompress the spinal cord and abort the inflammatory process.

### 3. Results

We included 21 patients with bilharzial conus lesions during the period from July 2009 to January 2020. Age and sex incidence: The age ranged from 8-12 years with a mean age 9.8 years. Twenty (95.2%) were males while one (4.8%) was female.

#### 3.1. Clinical picture

Lower back pain was present in all patients while retention of urine in 20 patients (95.2%). Hypothesia was present in all cases and it was bilateral in 20 patients (95.2%) and unilateral in only one patient (4.8%). Urinary examination for *S. haematobium* ova was negative in all patients, while Stool examination for *S. mansoni* ova was positive in one patient (4.8%). Serum anti-bilharzial antibodies were positive in all cases, tab. (1).

#### 3.2. MR Imaging results

All patients underwent MR imaging of the dorso-lumbar spine before and after

surgical or medical treatment. All MRI studies had been obtained by using 1.5-T machine (Philips-Acheiva, Netherlands), using a surface coil with the patient in a supine position and the arm at the side. Pulse sequences included axial and sagittal T1-weighted images (TR/TE= 500/15 milliseconds) before and after gadolinium-diethylenetriamine pentacetic acid (Gd-DTPA) intravenous injection (0.2 ml/kg body weight) and axial and sagittal fast spin echo T2-weightd images (TR/TE= 3500/120 milliseconds). Section thickness was 3 mm with a 0.3 mm inter-section gap. The field of view was 19-26 cm. MRI of intraspinal lesion was assessed as regard; the site, size, contour, signal intensities, and pattern of contrast enhancement. All pre- and post-treatment MR images were evaluated by the radiologist coauthor. MRI of all patients showed mild to moderate expansion of the distal spinal cord and conus medullaris. The signal intensity of the lesion was patchy hyperintense on T2-weighted images and isointense to the cord on T1-weighted images, fig. (1-a & b). The length of the involved cord segments ranged from 2 to 3 vertebral heights. Abnormal post contrast enhancement of the lesion was detected in all patients, fig. (1-c) where two patterns of enhancement are detected; the first is thick linear enhancement, fig. (1) and the other is focal mass-like enhancing nodule, fig. (2).

Table (1) Demographics, clinical manifestations and laboratory findings

Item	No	%
<b>Sex:</b>		
Male	20	95.2 %
Female	1	4.8 %
<b>Clinical manifestations:</b>		
Lower back pain	21	100 %
Retention of urine	20	95.2 %
Hypothesia		
Unilateral	1	4.8 %
Bilateral	20	95.2 %
Lower limb paresis		
Unilateral	12	57.1 %
Bilateral	2	9.5 %
<b>Laboratory findings:</b>		
Urine exam for <i>S. haematobium</i> ova	0	0 %
Stool exam for <i>S. mansoni</i> ova	1	4.8 %
Serum Anti-bilharzial antibodies	21	100 %

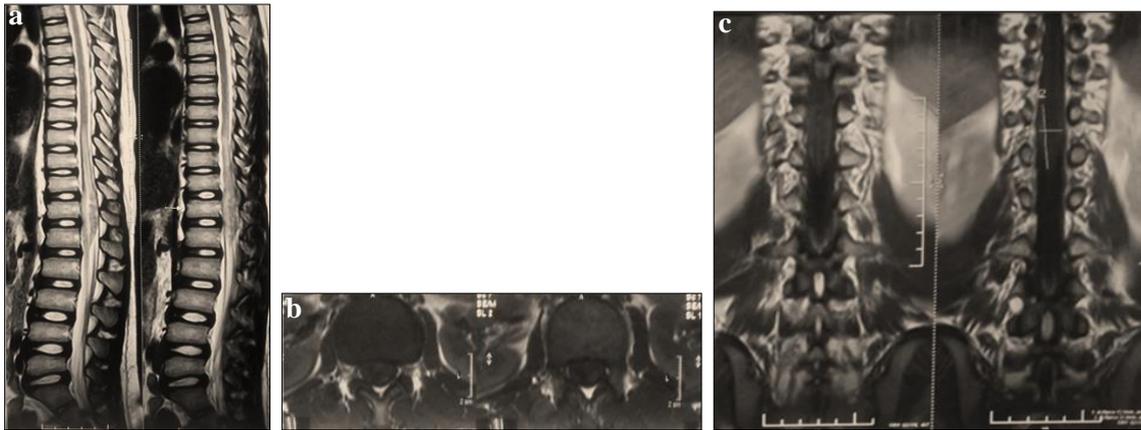


Figure (1) Case number 1: 12 years old male patient, a. Sagittal T2 weighted image showing patchy hyperintense lesion opposite to vertebrae T10, 12 and L1, b. Cross sectional T2 image showing enlargement of the cord, c. Post Gadolinium coronal image showing linear enhancement.



Figure (2) Case number 2: 11 years old male patient, a. & b. Sagittal T2 weighted image showing patchy hyperintense lesion opposite T10, 11, 12 to lumbar 2 vertebrae, c. & d. Post Gadolinium sagittal cross image showing focal mass-like enhancing nodule opposite T10, 11, 12 to lumbar 2 vertebrae.

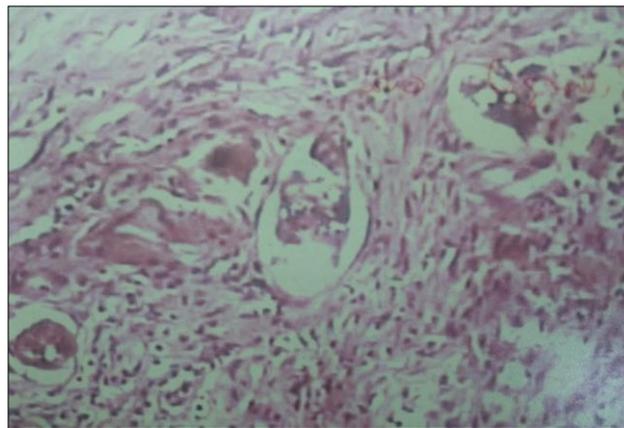


Figure (3) Histopathological examination of the resected material of conus medullaris lesion from 14 years old case showing diffuse heavy inflammatory reaction rich in eosinophils surrounding old few calcified bilharzial ova.

### 3.3. Treatment

Anti bilharzial drugs and corticosteroids were given to all patients. Physiotherapy was done for 14 patients (66.7%), while

surgery was done in 4 patients (19%). After medical treatment, complete improvement was achieved in 15 patients (71.4%),

partial improvement in 2 patients (9.5%) while no improvement occurred in 4 cases (19%). Surgery was done in cases of failure of medical treatment and physiotherapy in patients. One case (4.8%) improved completely, another case improved partially while no improvement occurred in 2 cases (9.5%) as shown in tab. (2). After surgery, one case developed

bilateral foot drop and increased paresis, tab. (3). After 3 months from medical treatment, the anti-bilharzial antibodies titre decreased in 2 cases (9.5%) and showed no change in 19 cases (90.5%). Follow up MRI showed complete resolution in five cases; one case (4.8%) surgically excised and 4 cases (19%) after medical treatment alone, tab. (4).

Table (2) Types of treatment, and response to medical treatment, physiotherapy and surgical treatment

Item	No	%
<b>Types of treatment</b>		
Anti-bilharzial drug	21	100 %
Corticosteroids	21	100 %
Physiotherapy	14	66.7 %
Surgery	4	19 %
<b>Response to medications and physiotherapy</b>		
Complete improvement	15	71.4 %
Partial improvement	2	9.5 %
No improvement	4	19 %
<b>Response to surgical treatment</b>		
Complete improvement	1	4.8 %
Partial improvement	1	4.8 %
No improvement	2	9.5 %

Table (3) Complications of surgery

Item	No	%
Bilateral foot drop	1	4.8 %
Increased paresis	1	4.8 %

Table (4): Follow up anti-bilharzial antibodies titre and MRI

Item	No	%
<b>Anti-bilharzial antibodies titre</b>		
Decreased titre	2	9.5%
Still as pretreatment level	19	90.5%.
<b>MRI:</b>		
Mass was completely resolved		
After medical treatment	4	19%
After surgical excision	1	4.8%
Mass does not resolute	16	76.2%

## 4. Discussion

Ferguson reported the first case of schistosomal myelopathy in an Egyptian who had had urinary Schistosomiasis [16,17]. Faust, in 1948, published the first review of ectopic schistosomiasis within 8 of his 82 patients having had signs of spinal cord involvement. He was the first to draw attention to the serious consequences of the delay in diagnosing the condition [18]. Since then, several case reports and case series have been published in the literature [19-21].

### 4.1. Age and sex

In our study, males were 20 cases (95.2%) while only one case was a female (4.8%). The age of the patients ranged from 8-12 years with a mean age of 9.8 years. This is not similar to what has been noted by Kabatereine et al; who found schistosomiasis affect age 10 to 20 years [22]. This can be explained by the recreational habits in kids and the higher tendency in boys more than girls in getting exposed to infected water in endemic areas. Some authors hypothesize that differences in

pelvic anatomy could be responsible for this gender difference [5].

#### **4.2. Presentation**

Almost all of our patients presented acutely or subacutely with low back pain, retention of urine, bilateral hypoesthesia and unilateral lower limb paresis. Similar to our study, Olson et al. [12], and Ferrari et al. [11] found that the most frequent initial complaint is low back pain observed in 79-100% of cases. Also, Ferrari and Moreira reported that all of these signs have been recorded in more than 87% of the cases [23]. The clinical features of Schistosomal Transverse Myelitis (STM) can mimic those of lower spinal cord tumor and other causes of transverse myelitis [19].

#### **4.3. Laboratory findings**

In our study, urine examination for *S. haematobium* ova was negative in all patients, while stool examination for *S. mansoni* ova was positive in one patient (4.8%). Lack of other systemic manifestations of schistosomiasis and difficulty in detecting eggs in the urine or stool of STM patients has been reported and is not uncommon [24]. In our study, serum anti-bilharzial antibodies were positive in all cases. Antibody detection in the blood and cerebrospinal fluid (CSF) of suspected cases can support the diagnosis of neuroschistosomiasis [25,26].

#### **4.4. MR Imaging results**

In our study, MR images of all patients showed mild to moderate expansion of the distal spinal cord and conus medullaris. The signal intensity of the lesion was patchy hyperintense on T2-weighted images and isointense to the cord on T1-weighted images as shown in figures above. The average length of the involved cord segments ranged from 2 to 3 vertebral heights. Abnormal post contrast enhancement of the lesion was detected in all cases where two patterns of enhancement were detected, the first is focal mass-like enhancing nodule, and the other was thick linear enhancement. Magnetic resonance imaging (MRI) plays an important role in diagnosis of intramedullary lesions and

is associated with a higher specificity and sensitivity compared with other radiological diagnostic methods [27,28]. The spinal cord schistosomiasis has the following characteristics in MRI findings: **1)** The most common location is the conus medullaris; **2)** There is swelling of the spinal cord with ill-defined hyperintense lesion on T2-weighted image and equal or hypointense on T1-weighted image; **3)** It shows single or multiple irregular enhancing patches on contrast enhanced T1-weighted image corresponding to granulomatous inflammatory response inside the cord. Intramedullary space occupying lesion from spinal cord schistosomiasis has many differential diagnoses including ependymomas, astrocytomas, lipoma, hemangioma, epidermoid cyst, dermoid cyst, transverse myelitis and metastatic tumor. It is difficult to distinguish ependymomas or astrocytomas from spinal cord schistosomiasis by their clinical manifestations. However, MRI of ependymomas shows that there is sharply defined image, which cannot be found in spinal cord schistosomiasis. The phenomenon of intramedullary cavities can be observed in MRI of astrocytomas. The MRI of lipoma is characterized by that T1 and T2 images are high intensities. Signal voids can be found in MRI of hemangioma, and the rich blood supply can be observed further in angiography. The uneven signal display in MRI may be a main characteristic of epidermoid and dermoid cyst. However, it is difficult to distinguish spinal cord schistosomiasis from transverse myelitis. Edema and non-occupying lesions signal displayed in MRI is a main characteristic of transverse myelitis. MRI, help the clinician in narrowing down the preoperative diagnostic possibilities and assist the surgeon in planning and carrying out surgery [29].

##### **4.4.1. Types of treatment given**

In our study, all cases were treated by: **1)** Medical treatment in the form of Praziquantel (one single oral dose of 50 mg/kg), repeated after one week, intravenous methylprednisolone (1 g/day, for 3 days),

followed by dexamethasone for 12 days and prednisolone (1 mg/kg/day, for 30 days). **2)** Physiotherapy. **3)** Surgery: With failure of medical treatment and physiotherapy.

#### 4.4.1.1. *Praziquantel*

Praziquantel is the anthelmintic drug of choice for the treatment of all types of schistosomiasis with virtually little or no side effects. Besides, it also has ovicidal, anti-inflammatory and immunosuppressive actions [30]. Usually it is given as a single dose for schistosomiasis, a commonly used dose for cases of neuroschistosomiasis is 40-60 mg/kg/day for 3 days [23]. Single-day treatment with Praziquantel is safe and effective in systemic schistosomiasis, although resistance has been reported in some African countries. In this study the protocol was a single dose of 50 mg/kg and repeated after one week.

#### 4.4.1.2. *Corticosteroids*

We used dexamethasone in all patients. It is a potent anti-inflammatory and immunosuppressive agent and helps stabilize cellular membrane hence, rapidly reducing the spinal cord edema. Moreover, dexamethasone is approximately 7 times stronger than Prednisolone. Dexamethasone was given orally at a dose 100 micrograms/kg/day for children under 12. The drug was gradually tapered off over 4 to 6 weeks' time. All patients except one tolerated the treatment well. Cases presented lately showed partial or no improvement despite of repeated doses of medications. This coincides with previous literature reports about the advantages of early diagnosis and treatment [24]. Rapid improvement of acute schistosomal myelitis has been reported after use of corticosteroids, but no double-blinded studies have been performed [31-33]. If eggs were detected in the stool or the urine prior to therapy, these should be re-examined 1 month after treatment to assess the efficacy of medical treatment.

#### 4.4.1.3. *Surgery*

Surgical excision of the lesion in combination with medications is a useful strategy to treat spinal cord Schistosomiasis. Others

have the following experience in surgical treatment of spinal cord schistosomiasis japonica: **1)** for large lesions, maximum safe resection of the lesion, to reduce foci pressure by using ultrasonic aspirator or laser instrument to stop bleeding **2)** use cotton sliver when separating the lesion from normal tissue for the sake of protection; **3)** any changes in SSEP and MEP are reminders of reassessment of operation method and resection degree [34]; **4)** protection of the function of the spinal cord is a top priority throughout operation. In addition, pathological examination is very necessary for the diagnosis of schistosomiasis japonica [7,29]. In our study four cases were treated by surgery trying maximum safe resection of the lesion, one case improved completely, another case improved partially while no improvement occurred in two cases.

#### 4.4.2. Response to medical treatment, physiotherapy, and surgery

After medical treatment and physiotherapy, complete improvement was achieved in 15 patients (71.4%), partial improvement in 2 patients (9.5%) while no improvement occurred in 4 cases (19%). Surgery was done in 4 cases after failure of medical treatment and physiotherapy. One case (4.8%) improved completely, another improved partially while no improvement occurred in two cases (9.5%).

## 5. Conclusions

*Conus medullaris lesions in areas endemic with bilharziasis should trigger the possibility of bilharziasis. Early diagnosis of bilharziasis of conus medullaris by MRI and positive anti-bilharzial antibodies is essential for early management and to avoid unnecessary surgery and complications.*

## References

- [1] Jordan, P. (1985). *Schistosomiasis*. The St Lucia project, Cambridge University Press, London.
- [2] Engels, D., Chitsulo, L., Montresor, A., et al. (2002). The global epidemiological situation of schistosomiasis and new approaches to control and

- research. *Acta tropica*. 82 (2): 139-146.
- [3] WHO Expert Committee. (2002) *Prevention and control of schistosomiasis and soil-transmitted helminthiasis*. World Health Organ Tech Rep Ser.; 912: i-vi.
- [4] El Fatih, M., Mohamed, A., Jabir, A., et al. (2011). *Neuroschistosomiasis in Sudan*. Sudan Med J. 47 (2): 75-85.
- [5] Palin, M., Mathew, R., Towns, G. (2015). Spinal neuroschistosomiasis. *Br J. Neurosurg*. 29 (4): 582-4.
- [6] Elkhayat, R., Girgis, M. (1993). Bilharzial granuloma of the conus: Case report. *Neurosurgery*. 32 (6): 1022-1024.
- [7] El Banhawy, A., Elwan, O., Taher, Y. (1972). Bilharzial granuloma of the conus medullaris and cauda equina. *Spinal Cord*. 10: 172-180.
- [8] Ferrari, T. (2004). Involvement of central nervous system in the schistosomiasis. *Mem Inst Oswaldo*. 99 (5 Suppl 1): 59-62.
- [9] de Wilton, A., Aggarwal, D., Jäger, H., (2021). Delayed diagnosis of spinal cord schistosomiasis in a non-endemic country: A tertiary referral centre experience. *PLoS Negl Trop Dis*. 15 (2): e0009161.
- [10] Kane, C. & Most, H. (1948). Schistosomiasis of the central nervous system: Experiences in World War II and a review of the literature. *Archives of Neurology & Psychiatry*. 59 (2): 141-183.
- [11] Ferrari, T., Moreira, P., Cunha, A. (2004). Spinal cord schistosomiasis: A prospective study of 63 cases emphasizing clinical and therapeutic aspects. *J. of Clinical Neuroscience*. 11 (3): 246-253.
- [12] Olson, S., Rossato, R., Guazzo, E. (2002). Spinal schistosomiasis. *J. of Clinical Neuroscience*. 9 (3): 317-320.
- [13] Domingues, A., Barbosa, C., Agt, T., et al. (2020). Spinal neuroschistosomiasis caused by *Schistoma mansoni*: cases reported in two brothers. *BMC Infect Dis*. 20 (1): 724.
- [14] Araujo, M., & de Carvalho, E. (2006). Human schistosomiasis decreases immune responses to allergens and clinical manifestations of asthma. *Chem Immunol Allergy*. 90: 29-44.
- [15] Saconato, H. & Atallah, A. (2000). Interventions for treating schistosomiasis mansoni. *Cochrane Database Syst*. (2): CD000528
- [16] Ferguson A. (1913). The lesions of Bilharzial disease. *Glasgow Med J*.; 29 (1): 14-23.
- [17] Ferguson, A. (1917). Some notes on Bilharziasis. *BMJ Military Health*. 29: 57-65.
- [18] Faust E. (1948). An inquiry into the ectopic lesions in schistosomiasis. *American J. of Tropical Medicine*. 28 (2): 175-199
- [19] Control CFD. (1984). Acute schistosomiasis with transverse myelitis in American students returning from Kenya. *MMWR*. 33 (31): 445-447.
- [20] Carod-Artal, F. (2008). Neurological complications of *Schistosoma* infection. *Transactions of the Royal Society of Tropical Medicine and Hygiene*. 102 (2): 107-116.
- [21] Ferrari, T., Moreira, P., Cunha, A. (2008). Clinical characterization of neuroschistosomiasis due to *Schistosoma mansoni* and its treatment. *Acta tropica*. 108 (2): 89-97.
- [22] Kabatereine, N., Brooker, S., Tukahebwa, E., et al. (2004). Epidemiology and geography of *Schistosoma mansoni* in Uganda: Implications for planning control. *Tropical Medicine & Int. Health*. 9 (3): 372-380.
- [23] Ferrari, T. & Moreira, P. (2011). Neuroschistosomiasis: Clinical symptoms and pathogenesis. *The Lancet Neurology*. 10 (9): 853-864.
- [24] Bill, P. (2003). Schistosomiasis and the nervous system. *Practical Neurology*. 3 (1): 12-21.
- [25] Nicolls, D., Weld, L., Schwartz, E., et al. (2008). Characteristics of schist-

- osomiasis in travelers reported to the geo sentinel surveillance network 1997-2008. *The American J. of Tropical Medicine and Hygiene*. 79 (5): 729-734.
- [26] Hamilton, J., Klinkert, M., Doenhoff, M. (1999). Diagnosis of schistosemi-asis: Antibody detection, with notes on parasitological and antigen detection methods. *Parasitology*. 117 (07):41-57.
- [27] Nazer, H., Hugosson, C., Posas, H. (1993). Transverse myelitis in a child with Down's syndrome and schistosomal colitis. *Annals of Tropical Paediatrics*. 13 (4): 353-357.
- [28] Selwa, L., Brunberg, J., Mandell, S., et al. (1991). Spinal cord schistosomiasis: A pediatric case mimicking intrinsic cord neoplasm. *Neurology*. 41 (5): 755-757.
- [29] Jiang, Y-G., Zhang, M-M., Xiang, J. (2008). Spinal cord schistosomiasis japonica: A report of 4 cases. *Surgical Neurology*. 69 (4): 392-397.
- [30] Ferrari, M., Coelho, P., Antunes, C., et al. (2003). Efficacy of oxamniquine and praziquantel in the treatment of *Schistosoma mansoni* infection: A controlled trial. *Bulletin of the World Health Organization*. 81 (3):190-196.
- [31] Andrade, F., Queiroz, A., Freire, A., et al. (2007). Pseudotumoral form of neuroschistosomiasis: Report of three cases. *The Brazilian J. of Infectious Diseases*. 11 (4): 435-438.
- [32] Gellido, C., Onesti, S., Llana, J., et al. (2000). Spinal schistosomiasis. *Neurology*; 54 (2): 527
- [33] Silva, L., Maciel, P., Ribas, J., et al. (2004). Treatment of schistosomal myeloradiculopathy with praziquantel and corticosteroids and evaluation by magnetic resonance imaging: A longitudinal study. *Clinical Infectious Diseases*. 39 (11): 1618-1624.
- [34] Adams, D., Emerson, R., Heyer, E., et al. (1993). Monitoring of intra-operative motor-evoked potentials under conditions of controlled neuromuscular blockade. *Anesthesia & Analgesia*. 77 (5): 913-918.