Intracranial Bilharzia

BY

LAURENCE F. LEVY,
M.SC., F.R.C.S.,
Professor of Surgery,

BASIL J. BALDACHIN,
F.R.C.P.E., D.C.H. (LOND.),
Consultant Physician,

AND

DAVID CLAIN,
M.D., M.R.C.P.,
Consultant Physician
University of Rhodesia, Salisbury, Rhodesia.

Bilharzia is a disease of the lower bowel and bladder where the effects of lesions and their complications are well known. Nonetheless, ova and occasionally flukes have been found in almost every part of the body. Turner (1908), Bersohn and Lurie (1953) Kane and Most (1948).

Monteiro de Barros (1956) saw ova of *S. Mansoni* in the brain and adult parasites in the leptomeninges, and Gelfand (1950) using digestion technique of warm sodium hydroxide, systematically examined 50 brains in subjects suffering from intestinal and urinary bilharziasis and found eggs present in 28 cases. They were widely disseminated in the brain tissue and it was noted that the tumour form of egg granuloma was rare in these species

though common in Japonicum. In 2 000 autopsies performed in the African hospital in Salisbury none had space occupying lesions caused by bilharzial eggs.

Chitiyo (1972) performed an autopsy on an African woman who died of bronchial carcinoma and found calcified ova of *S. haematobium* in the choroid plexus together with adult schistosomes.

Gelfand's (1950) work in demonstrating ova in 56 per cent. of brains of patients suffering from visceral schistosomiasis all but one of whom had no symptoms referable to the nervous system, emphasises the fact that involvement of the CNS in schistosomiasis may be much greater than we would suspect from the relatively few cases reported in the literature from endemic areas.

In an endemic area where well over half of the population is affected, Blankfein (1965) states that 2-4 per cent. of the sufferers will develop cerebral complications.

In patients with infestation of the CNS it is interesting that whereas *S. mansoni* and *S. haematobium* have shown a predilection for the spinal cord, Japonicum tends to involve the brain.

However, more cases of the first two species involving the brain have appeared in the literature, and on reviewing them the distribution of species involvement would seem to be as follows:

CORD		BRAIN	
S. mansoni	32	*S. mansoni*	16
S. haematobium	13	*S. haematobium*	5
S. japonicum	2	*S. japonicum*	110

Levy and Taube (1969), Gear (1961), Blankfein and Chirico (1965), Torres (1965), Odeku (1968).

With a steady increase in water conservation and with more people moving around in bilharzial contaminated areas, we have had occasion to see a number of cases which we consider are examples of cerebral bilharziasis due to *S. mansoni* and *S. haematobium*.

We have classified these as acute, subacute and chronic cerebral bilharziasis, although meningitic and encephalitic pictures can be detected.

Case No. 1 Acute cerebral Bilharziasis-Encephalitic Type.

Mr. A. R., a 20 year old European, was admitted to hospital on the 31st December, 1969. At the beginning of 1969 he had a negative bilharzial skin test and a normal eosinophil count. He had been well until April, 1969, when he had a brief episode of "collapse" which was thought to be due to heat exhaustion.

During the year he had spent a considerable period in a heavily contaminated area, and on his return to Salisbury on the 14th December, 1969, was found to have an eosinophilia of six per cent. and a positive bilharzial skin test. During the first week of December he had vomited and felt ill, and just before Christmas had a short bout of diarrhoea.

The patient was well on the morning of the 29th December, 1969, but that evening he was seen to behave strangely and the following morning, although he appeared to be conscious, he did not answer any questions and remained at rest in his room. On 31st December, 1969, he was found in a strange stupor in which he did not reply to simple questions, but would respond to commands to put out his tongue and lift a limb. He yawned occasionally and smiled. He could not be induced to move his eyes though the lids were open. His hearing appeared normal. There was a slight weakness of the left side of the face, but sensation appeared normal. He was incontinent of urine. He was treated with chloroquine, quinine and intramuscular penicillin.

During the course of the next few days the weakness of the left side of the face progressed to an almost total left hemiplegia.

1.1.70. Lumbar puncture C.S.F. pressure 145 mms, protein 45 mgm%. Sugar 75 mgm%. Cells not reported. Cone Stain — negative parasites. Direct stain — negative parasites. Slide (12 midnight) — negative parasites. Wet direct film — negative parasites. Direct stain film — negative parasites Concentration stain film — negative parasites. Rectal snip — showed many viable ova of *S. mansoni*. Treatment with S.A.T. and intravenous cortico-steroids was started. Within one hour of the S.A.T. injection the patient suffered a series of epileptic fits lasting for 35 minutes. Phenobarbitone 30 mg was administered before each dose of S.A.T. of which the patient received 1 440 mg over 14 days.

3.1.70. E.E.G. A severely abnormal overall slow high voltage record maximum frontally indicating an encephalopathy. E.C.G. — normal. Lumbar puncture normal.

5.1.70. Answering questions. Weakness left arm. S.A.T. 118 mg. I.V. Lumbar puncture — 150 mm. C.S.F. Protein 40 mg%. WBC less than 1/cmm.

6.1.70. Rat inoculation for blood parasites — negative. Hb 109%, WBC 12,300 (N. 44%, L. 14%, B. 1%, E. 41%, 5043/cm). Sedimentation rate — 26 mm in one hour.

8.1.70. Hemiplegia had begun to regress.

9.1.70. Liver function tests — normal. Lumbar puncture — pressure 130 mms C.S.F., Protein mg 57%. Sugar mg 15%, WBC less than 1/cm. Stool — ova of *S. mansoni* found. Urine — no ova found.

13.1.70. Hb 99%, WBC 9,400/cu.mm (N. 39%, L. 15%, M. 9%, E. 37%, 3,478/cu.mm).

14.1.70. E.E.G. — Overall slow record with ap-

pearance of some alpha demonstrating an improvement.

19.1.70. Lumbar puncture — pressure normal. C.S.F.Protein 56 mg% Sugar 63 mg%, WBC 2/cu. mm.

27.1.70. Hb 94%, WBC 11,900 (N. 52%, L. 31%, M. 2%, E. 15%, 1 785/cu.mm).

29.1.70. Arteriogram performed. ? blockage of right internal carotid artery? Technical defect.

1.2.70. Conscious level greatly improved and able to carry on simple conversation, but could not read any text and had difficulty with control over eye movements. Left hemiplegia still present principally involving the arm.

5.2.70. Urine and stool specimens negative for bilharzial ova.

20.2.70. Hb 97%, WBC 9,100/cu.mm (N. 50%, L. 40%, M. 1%, E. 9%, 810/cu.mm). Sedimentation rate — 7 mm in one hour.

19.3.70. Discharged. Residual left hemiparesis. Eye movements full and equal. Although the right side of the body was not obviously affected, he had great difficulty in writing.

5.10.70. E.E.G. showed 10-11 c/s alpha rhythm better organised on the right side. Overbreathing again evoked theta and delta activity maximum anteriorly which spread backwards over the head at diminished voltage and showed no substantial change from the previous record which was taken in March, 1970.

Case No. 2 Acute Cerebral Bilharziasis meningitic Type.

Mr. K.S., an 18 year old European male was admitted to hospital on the 22nd October, 1970. He had suffered from severe frontal headache since the previous night and had vomited two or three times since the onset. His neck felt stiff, but there was no photophobia. He had suffered from rheumatic fever two years previously, and had had bilharziasis at the age of eight years. He had had frequent exposures to bilharziasis the last being a few months previously.

On examination, he was obviously ill and in pain. He had frequent early ectopic cardiac beats and a soft apical systolic murmur. B.P. was 130/80. There was mild neck rigidity with a positive Kernig's sign.

22.10.70. Lumbar puncture, pressure 190 mm of C.S.F., protein 180 mg%; Pandy's Test—positive. 485 WBC's per cu.mm (P. 35% — 121, L. 43% — 210, E. 33% — 154). There were 10 RBC's /cu.mm. Glucose 53 mg%. No tubercle or other bacilli seen, culture sterile. Hb 18,3 gm%, WBC's 8,100/cu.mm. (P. 61%, L. 18%, E. 16%, 1,701/cu.mm). ESR 5 mm per hour.

23.10.70. Faecal Examination — no ova seen. Urine Examination — a few red and white corpuscles seen.

26.10.70. Lumbar puncture — pressure 210 mm. CSF, turbid fluid, no clot, protein 45 mg%, WBC's 3,500/cu.mm. (P. 2% — 7, L. 32% — 112, M. 2% — 7, E. 64% — 324). RBC less than 1/cu.mm.

28.10.70. Faecal and urine examination — no ova found. Rectal snip — calcified bilharzia ova seen. A.S.O. Titre 12 units.

30.10.70. E.E.G. very mild irregularity and an otherwise normal tracing.

4.11.70. Bilharzia skin test — positive, Blood eosinophils 13%. Urine negative for bilharzial ova. Ova of *S. haematobium* (apparently viable) found in one stool. Repeated examination of the blood showed no microfilaria. The patient was given Hycanthone 180 mg in one dose with prednisolone 5 mg four times daily for four days. The cardiac arrhythmia did not respond to propranolol or quinidine and no cause could be found for this.

6.11.70. Lumbar puncture, CSF protein 40 mg%, WBC 98/cu.mm. (L. 88% — 88, P. 12% — 10, E. Nil).

23.11.70. Lumbar puncture CSF protein 30 mg%, WBC's 45/cu.mm. (L. 92% — 41/cu.mm., P. 8% — 4/cu.mm). Patient felt well; no further headache or stiffness of neck.

Case No. 3 Subacute Cerebral Bilharziasis Encephalitic Type.

Mr. M.W., an African cleaner, aged 28 worked in a yacht club. In the middle of October, 1969, he suddenly suffered a severe generalised convulsion having previously been well. Physical examination at that time revealed no abnormality. He was admitted to hospital on the 4th November, 1969.

17.10.69. E.E.G. abnormal with diffuse slowing.

21.10.69. Lumbar puncture — pressure 125 mm CSF protein 85 mg%. Less than one white cell/cu.mm, 373 RBC's/cu.mm glucose 64 mg% V.D.R.L. negative.

7.11.69. Hb 107% WBC 9,800 (N. 17%, L. 35%, M. 2%, E. 46%, 4,508/cu.mm). V.D.R.L. negative. Serum calcium 5,8 mEq/L. Blood urea 21 mg% Electrolytes normal.

12.11.69. Stools showed viable ova of *S. mansoni* and hookworm. Urine examination N.A.D. X-ray chest, thighs and skull — clear, no calcified cysticerci seen.

10.11.69. Lumbar puncture — pressure 175 mm C.S.F. protein 100 mg%. WBC's 3/cu.mm, Glucose 65 mg%, Lange 1111100000. Had two further seizures.

17.11.69. Hb 110% WBC's 5,600 (N. 44%, L. 23%, M. 1%, E. 32%, 1,792/cu.mm.)

19.11.69. Ambilhar 1½ tabs. twice daily commenced — nine days.

6.12.69. Lumbar puncture pressure 230 mm CSF protein 47 mg%. Less than one white cell/cu.mm. Pandy's Test — negative.

10.12.69. Discharged on phenobarbitone 60 mg twice daily and phenytoin mg 50 twice daily.

24.12.69. E.E.G. Abnormal record similar to previous test.

23.4.70. E.E.G. This is again an abnormal, slow and paroxysmal record maximum anteriorly, irregular delta activity occurs, but the abnormality is more marked than previously. There is a deterioration.

28.4.70. Urine test — normal. Hb 110%, WBC 6,200 (N. 57%, L. 36%, E. 7%, 434/cu.mm).

8.6.70. E.E.G. Similar to the previous test.

28.1.71. E.E.G. remains abnormal. The patient has had no further seizures. He has been taking phenobarbitone 60 mg and phenytoin 50 mg twice daily.

Case No. 4 Subacute Cerebral Bilharziasis (Encephalitic Type)

A.M., a 13 year old European schoolboy appeared well on the morning of the 22nd Jan-

uary, 1969. That evening, however, he noticed his vision was blurred, and he knocked over a cup of tea. He went to get a tea towel and found that his right arm would not move; almost immediately this was followed by some twisting of his right leg. He then went into a "sideways" spasm, with twitching, rolling eyes and unconsciousness for four minutes. He did not bite his tongue nor was he incontinent, but the following day he dragged his right foot. This soon recovered. He had recently been visiting the Zambezi River near Livingstone.

25.1.69. E.E.G. N.A.D. — (Dr. J. C. Davidson). He was given 15 mg phenobarbitone three times daily.

29.1.69. Further seizure, starting again with difficulty of vision. Left arm and leg in spasm, eyes turned to the left with pronounced nystagmus.

17.2.69. Third seizure. Pain behind the right eye with loss of vision and mild generalised convulsion.

26.2.69. X-ray skull normal. Hb 12,2 gm%. WBC 10,000 per cu.mm. (N. 35%, L. 38%, E. 27%, 2,727/cu.mm).

27.2.69. Urine examination NAD. Stool examination — ova of *S. mansoni* found (also found in his sister). He was treated with Ambilhar and made a spontaneous recovery.

12.9.69. Seen in the epilepsy clinic at the Cardiff Royal Infirmary. No abnormal neurological findings and no seizures. E.E.G. showed scattered theta waves in all areas.

Case No. 5 Subacute Cerebral Bilharziasis (Encephalitic Type)

A 19 year old European male was admitted to hospital on the 26th September, 1970. He had previously been exposed to bilharzia. Subsequently he found that if he undertook any form of physical exertion he would get a very bad tremor in all limbs, and if he persisted with the exercise he could become briefly unconscious. On the day of admission he suffered a major seizure following some particularly severe exertion after which he remained restless and confused for a number of hours. On examination at that time there was no abnormal CNS findings. Patient had been treated by an intramuscular injection of Etrenol on the 30th June, 1970.

26.9.70. Lumbar puncture — CSF pressure normal. Protein 70 mg%. WBC less than 1 per cu.mm. Sugar 64 mg%, RBC 230/cu.mm. Blood sugar 162 mg%. WBC 9,500 (N. 49%, L. 37%, M. 6%, E. 8%, 760/cu.mm).

28.9.70. Blood urea 29 mg%.

29.9.70. E.E.G. report. Asymmetric record with a well organised alpha rhythm in the right hemisphere interspersed with random theta waves. The left hemisphere is of low voltage and consists of irregular alpha and theta activity.

5.10.70. E.E.G. Normal record.

8.10.70. Lumbar puncture. CSF protein 60 mg%, WBC 124/cu.mm, all Lymphocytes. Sugar 67 mg%, Chlorides 790 mg%. Bilharzia skin test — positive. Eosinophils 12%. Urine — NAD. Stool — Viable ova of *S. mansoni* seen. Slides negative for trypanosomes, malaria and filaria.

9.10.70. Stools show ova of *S. mansoni.*

10.10.70. Hb 105%, WBC 10,00/cu.mm (N. 52%, L. 38%, M. 2%, E. 6%, 606/cu.mm).

11.10.70. Etrenol 200 mg. I.M.I. at 3.15 p.m.

11.1.71. No anticonvulsants since treatment — no seizures. Patient feels very well.

Case No. 6 Chronic Cerebral Bilharziasis (Encephalitic Type)

An 18 year old European male suffered his first seizure in January, 1967, the second in December, 1967, and the third in January, 1968. During the first attack he was briefly unconscious. The second seizure occurred while he was walking. He suddenly felt himself shaking and became briefly unconscious. After a short warning he was unconscious for approximately half an hour in his third attack. He stated that he had never had bilharziasis, but suffered from cerebral malaria at the age of 12 years.

8.3.68. X-ray of skull and chest — normal.

8.3.68. Hb 91%, 5,600 WBC/cu.mm (N. 54%, L. 30%, E. 16%, 896/cu.mm). Lumbar puncture — normal pressure and constituents.

15.3.68. Bilharzial skin test — positive. Ova of *S. mansoni* found in stools.

16.3.63. E.E.G. showed an abnormal paroxysmal record focal in motor-parietal areas bilaterally. The patient was treated with Ambilhar and when last heard of had no further seizures or trouble. He has, unfortunately, been lost to follow-up.

Case No. 7 Chronic Cerebral Bilharziasis (Encephalitic Type)

A 17 year old European male developed shaking of the left hand at 5 o'clock one morning in May, 1969, which rapidly changed into a generalised seizure. He quickly recovered, but was similarly attacked a few days later. He then remained well during the few weeks prior to attending for consultation. Examination showed no physical or neurological abnormality.

25.6.69. E.E.G. showed diffuse slowing during overbreathing maximum in the left hemisphere.

10.6.69. Stool — ova of *S. mansoni* seen. Urine — no ova found. E.E.G. repeated — similar to that of 26.5.69.

11.6.69. Hb 101, WBC 12,000 (N. 62%, L. 22%, M. 10%, E. 6% 720/cu.mm).

12.6.69. Blood sugar 88 mg%, Blood urea, 22 mg%, Serum cholesterol 253 mg%.

13.6.69. Lumbar puncture — CSF pressure normal. Protein 32 mg%. Less than 1 WBC per cu.mm, VDRL — negative. The patient was treated with Ambilhar and made an uncomplicated recovery.

Case No. 8 Chronic Cerebral Bilharziasis (Encephalitic Type)

This 24 year old European male complained of abdominal discomfort in October, 1967. Subsequently, he developed paraesthesia in the

right hand associated with twitching which recurred. He had recently been in a bilharzial contaminated area. He subsequently suffered a generalised seizure and later was observed by his doctor to have convulsive movements of the right leg and hand without loss of consciousness. He had been treated for bilharziasis with Ambilhar one month previously.

25.10.67. E.E.G. showed episodes of low voltage 7 c/s theta activity in the left motor area augmented and spread over the head by overbreathing, in a low voltage, poorly organised record. Urine examination — no bilharzial ova seen.

1.11.67. Bilharzial skin test — positive. 7% eosinophils. Three urine specimens — negative. Three stool specimens showed viable ova of *S. mansoni*.

4.11.67. Hb 98%, WBC 10,000. (N. 62%, M. 10%, E. 6%, 606/cu.mm). Lumbar puncture — CSF pressure normal. Protein 90 mg%. No cells. Further treatment with Ambilhar given.

6.11.67. Lumbar puncture performed. CSF pressure normal. Protein 50 mg%. E.E.G. showed a more diffusely abnormal record with slowing and sharp alpha transients.

30.1.68. E.E.G. showed low voltage fast record with mild slowing in the motor areas — an improvement.

7.2.68. The patient looked fit and had had no more attacks though he said that he has had some "fuzziness" of the left arm and leg.

8.5.68. E.E.G. There is still mild slowing with sharp alpha transients posteriorly.

19.8.68. Patient complained of attacks of shaking in the left hand and tingling of the left leg.

22.8.68. Lumbar puncture performed — CSF pressure normal. Protein 77 mg%, Less than 1 WBC/cu.mm.

28.8.68. Hb 105%, WBC 9,600. (N. 53%, L. 27%, M. 10%, E. 10%, 960/cu.mm).

23.8.68. Filaria skin test — negative. Bilharzia skin test — negative. Eosinophils 11%. Fresh blood films — negative filaria. Stained film — no microfilaria seen.

31.10.68. Hb 98%, WBC 7,900 (N. 56%, L. 40%, E. 4%). The patient has remained well since that time.

Discussion

1. Patient Backgroud

All eight patients were young European males, with the exception of the African yacht club worker, who, in the course of their duties or holidays had come into recent contact with waters known to be heavily infested with bilharziasis.

Their ages ranged from 13 years to 28 years. We are regarding them as cases of cerebral bilharziasis because they fill the following criteria:

1. History of recent exposure.

2. Ova isolated from stools or rectal mucosa.

3. Neurological symptoms referable to the brain for which no other cause could be found.

4. Clinical response to anti-bilharzial treatment.

In no case did we have reason or opportunity to biopsy the brain tissue.

2. Presenting Symptoms

With the excepion of case No. 2 who had bilharzia as a child and case No. 3 who had worked for some time around water likely to be infected, the patients all had what might be called an acute exposure to bilharzia in the last year or so before presenting. Unfortunately it has not been possible to determine with any accuracy the time interval between exposure and onset of neurological symptoms as many American workers have been able to do.

We have classified our patients as acute, subacute and chronic cerebral bilharziasis although encephalitic and meningitic pictures can be detected.

Incidence of Symptoms

Seizures	6
Inco-ordination or shaking	4
Vomiting	2
Diarrhoea or Abdominal Discomfort	2
Malaise	1
Headache	1
Nuchal rigidity	1
Speech	1
Visual disturbance	1
Sensory disturbance (Paraesthesiae)	1
Paresis	1

Six of our eight patients developed seizures and this appears to be the commonest mode of presentation of all types of cerebral bilharzia.

Watson, Murphy and Little (1947) state that the earliest symptom of cerebral involvement by the ova is usually focal seizures and the left hemisphere is most frequently involved. Their cases were all *S. Japonicum* with space occupying lesions. This is most probably true for our species as well. In some of our cases however the seizures were generalised rather than focal, and no neurological abnormality was present on clinical examination. This would tend to indicate wide-spread ova dissemination in cerebral tissue rather than a localised lesion.

We note that four cases presented with inco-ordination or shaking of a limb and this symptomatology might indicate a larger focus of irritative eggs in a particular area.

Speech, visual and sensory disturbances have been reported widely in the literature as modes of presentation: vomiting and malaise are prob-

ably part of the general systemic effect of the illness.

We cannot say whether the seizures were caused by the toxic effects of eggs in brain tissue or merely by their physical presence.

Incidence of Neurological Abnormality

Seizures (No abnormal signs)	5
Visual Disturbance	2
Hemiplegia	2
Stupor	2
Incontinence	1
Speech Disturbance	1
Kernigs Positive	1

3. Eosinophilia

All patients had a blood eosinophilia when they presented, the range being 6-46 per cent. and tending to fall with treatment.

Torres (1965) reviewed 38 proven cases of cerebral schistosomiasis reported in the world literature and found that the eosinophil count increased in most cases even if there is no significant leucocytosis. While Lurie and de Meillon (1952) believe that eosinophilia as a positive sign of infection occurs six weeks after the time of exposure, Levy and Taube (1969) point out that in bilharziasis of the spinal cord gross eosinophilia tends to occur early rather than later in the disease, possibly as part of an allergic response to the dissemination of cercaria throughout the body.

4. Ova Recovery

Ova were recovered from stool specimens in all eight patients and belonged to the species *S. mansoni* with the exception of case 2 where *S. haematobium* was isolated. Rectal snip confirmed ova present in cases 1 and 2. Ova are thought to be recoverable from the faeces eight weeks after the time of exposure but Piganiol (1956) reports a case of a 42 year old man who developed neurological symptoms following infection with *S. mansoni* but a diligent search for ova in the faeces resulted in their recovery only three months after the start of his illness.

5. Bilharzial Skin Tests

Four patients had positive bilharzial skin tests, three were not tested and case 1 had a negative test one year prior to infection which became positive when symptoms developed.

6. Lumbar Puncture Results

The CSF analysis was normal in five cases and abnormal in three cases. Case 2 is very interesting from the point of the CSF picture. Starting with a CSF pressure of 190 mm, a protein of 185 mg% and 485 WBC's per cu.mm at the onset of the disease, four days later he had turbid CSF the pressure of which was 210 mm CSF. The white cell count rose to 3,500 per cu.mm with a 64% eosinophilia at one time, though the protein was reported as only 45 mg%. Culture for TB and other bacilli was negative. We have classified this case as bilharzial meningitis because symptoms suggested such a diagnosis and he had a large number of cells in the CSF (485 per cu.mm) on admission. Case 3 showed a raised pressure (230 mm CSF) and protein (100 mg%) during the course of his illness, and case 4 had 124 white cells per cu.mm in an otherwise normal CSF specimen — of these 100% were lymphocytes.

Neto and Neto (1955) reported a survey done on 42 patients infected with *S. mansoni* but who had no neurological abnormality in an attempt to detect early changes which might suggest involvement of the CNS by the parasite. Specific changes did not occur, the cell count was normal in all and no eosinophils were present. However 10 cases had alterations in CSF pressure and protein content.

Torres (1965) likewise reports seven cases out of 19 with raised pressure and seven out of 23 with raised protein and only two out of 23 cases with raised white blood cell counts.

It would appear then that in about a third of cases with cerebral involvement changes in CSF protein and pressure can be expected, but the CSF as a definite diagnostic tool remains questionable.

S. japonicum cerebral infections have been shown by Blankfein and Chirico (1965) to cause a higher incidence of CSF change involving pressure, protein and cells possibly due to a higher egg load carried by the patient.

Electroencephalography

All eight patients had changes in their EEG's varying from an encephalitic picture in case 1, through mild irregularities and diffuse slowing in five cases to abnormalities in the motor areas in cases 6 and 8. Four cases showed marked improvement in their EEG's following treatment and four cases did not appear to have follow up EEG's. Piganiol's (1956) case showed discrete slowing predominant on the right but this appears to be after he had received treatment. Blankfein and Chirico (1965) report that EEG's were obtained in seven of their patients.

Two who were acutely ill showed marked foci of abnormality both of which were verified

as sites of ova deposition. Four out of five patients with late onset disease also had focal abnormalities though these were less well defined. All these cases appear to have been suffering from *S. japonicum* infestation. Because of the greater tendency towards granuloma formation seen in *S. japonicum* it is not surprising that a more focal type of EEG activity is seen.

Treatment and Follow Up

Five patients were treated with ambilhar, two with hycanthone and one with S.A.T. Sedation with phenobarbitone was required in two cases and steroids were given to cases 1 and 2. Five patients made a complete recovery, one was discharged on anticonvulsants but has remained well and seizure free and two had a residual defect. Case 1 was discharged with a left hemiparesis and case 8 experienced paraesthesia and shaking of the left arm and leg 10 months later but went on to a complete recovery.

It would appear from our cases and those reported elsewhere that prompt diagnosis and treatment leads to recovery but residual defects may occur in cases which have gross pathology at presentation.

Comment

We believe that in all these cases Bilharzia was the cause of the condition. The ill effects are produced by the ova gaining access to the nervous system. The living ova are very irritating and it has been stated by El-Mofty (1962) that mansoni eggs produce a more sclerosing granular tissue reaction than haematobium.

How the eggs gain access to nervous tissue remains a point of speculation. It has been widely postulated that eggs reach cerebral tissue by a process of embolisation from mesenteric and vesical veins and the liver to the brain via devious channels.

Carroll (1946) however, points out that the localised nature of the granuloma surrounding groups of *S. japonicum* eggs in the brain suggests a local origin of the ova. With the finding of a pair of adult worms in brain substance, we postulate direct oviposition by an ectopic gravid female or a pair of worms.

Venous anastomoses between systemic and haemorrhoidal veins may allow adult worms to gain access to the dural sinus.

Maturation of circulating cercaria in the brain itself remains a further possibility but would appear unlikely. The eggs passed by the different species vary in size and quantity excreted, and this may have a bearing on the type of cerebral lesion we see. *S. haematobium* are 150μ x 60μ in size and 300 ova are secreted per day. *S. mansoni* likewise, whilst *S. japonicum* are 90μ x 65μ in size and 3 500 ova are excreted per day. The latter species does not occur in Rhodesia but provides a comparison. In the spinal cord where *S. mansoni* and *S. haematobium* are the infective agents, many small granulomata are seen and neurological change seems to be related to the local pressure and toxic effects of these many small masses. Total, sometimes permanent paraplegia may result. By contrast, *S. japonicum* shows a tendency towards the development of larger intracranial granulomata which may cause so much pressure as to necessitate surgical intervention. Possibly here a gravid female is responsible for the discharge of large quantities of small eggs directly into cerebral veins and the small rudimentary spine of the Japonicum egg may assist dissemination; so that egg size, load and morphology may account to some extent for the species difference in pathological lesions. Chitiyo (1972) remarks that if adult *S. haematobium* schistosomes can traverse intracerebral vessels and deposit ova, so can the smaller *S. mansoni* and *S. japonicum* ova.

Intracranially, *S. japonicum* seems to have the following modes of presentation, all of which naturally shade into one another:

1. A diffuse toxic effect with disorientation, delirium and coma.
2. Cortical irritation with focal or generalised seizures.
3. Cortical damage with hemiplegia, visual field changes, aphasia, etc.
4. Increased intracranial pressure and brain tumour syndrome from large granulomata.

The situation regarding *S. mansoni* and *S. haematobium* in the brain is not so clear and certainly ova can be present without any symptoms being noted. However, there are cases in which it is equally clear that an acute reaction, very similar to that caused by *S. japonicum*, can occur, though to date no solitary mass requiring decompression by surgical means has been seen. It would appear that the body's reaction to the presence of ova depends on the degree of immunity of the individual, the degree of allergic response and the magnitude of the initial schistosomal invasion. A resident of an endemic area may develop no symptoms in the presence of widely disseminated ova in the brain because of those factors, whilst an allergic, non immune subject may show a fulminating type of cerebral schistosomiasis.

Our cases, with the exception of the yacht worker, all had a history of relevant comparatively recent exposure to heavily contaminated water, some had sustained a very severe infection and this was certainly suggested by the relatively high eosinophil counts noted in the blood. Coutinho Abath *et al.* (1960) suggest that hypersensitivity reactions may occur in certain individuals who are already infected and who sustain a later heavy infection. The African yacht worker may be such a case as he was most probably infected for some time before he presented with the seizure.

We have also wondered whether the cerebral symptoms encountered could be part of the Katayama syndrome which is an allergic and toxic reaction to the dissemination of cercaria around the body, or possibly to mature migrating schistosomes. Sanders, Zilberg and Lewis have reported two cases of cerebral abnormalities occurring in children who fulfilled the criteria for the diagnosis of Katayama fever. The first, a seven year old boy who also had cardiac involvement, developed an encephalitic picture about eight weeks after infection with *S. mansoni.* After treatment the EEG returned to normal over four months. The second, a nine year old girl had cardiac involvement and an encephalitic picture on EEG returned to normal seven weeks after antibilharzial treatment but she died later in chronic cardiac failure with evidence of myocarditis and pulmonary bilharziasis.

If the condition is one of hypersensitivity, these authors suggest that cardiac and cerebral tissue may be affected by immunological processes. If the cerebral symptoms in our patients were part of the Katayama syndrome they would occur early on in the infective process before egg laying commenced and our cases all had egg loads in the stools at the time of presentation which indicates an infection of at least eight weeks duration. Our patients presented later than we would have expected if this was part of the Katayama syndrome and we are not happy that they filled the criteria of fever, eosinophilia, splenomegaly and positive serological tests *in toto.*

The cause of the acute upset of brain function is not completely clear.

It is generally accepted that the symptoms of bilharzia anywhere in the body are not caused by the parasite itself which is quite inert but by the eggs which excite an inflammatory and fibrous reaction around themselves while living. Presumably the acute meningitic and encephalitic symptoms are produced by a large number of ova, scattered diffusely throughout the brain setting up irritative foci and inducing a vascular response but again the allergic status of the individual may influence the intensity of the symptomatology. In this matter we may take a lead from Torres (1965) who reports EEG changes in eight patients with localised lesions of *japonicum* in the brain. In all cases the EEG findings correlated with the actual lesions located in the convexity of the cerebral cortex. Supported by other reports in the literature (Blankfein and Chirico, 1965) (Piganiol, 1956) it would appear that patients presenting with focal symptoms have egg lesions in specific related areas of the brain and EEG changes in those areas correlate with the lesion site.

Sofia (1960) reports the case of a 13 year old Eritrean boy who presented with a Jacksonian type of seizure and who was suffering from *S. mansoni.* On the basis of the clinical picture he established that the lesion was situated on the foot of the right frontal convolution. Specific therapy healed the lesion and confirmed his diagnosis.

In our first case who developed a left hemiplegia it is most probable that a focus of eggs with surrounding fibrous tissue was responsible and healing brought partial recovery only. His stupor, visual disturbance and incontinence were possibly part of an allergic or toxic response to egg dissemination in cerebral tissue. The other patients who presented with transient motor disturbances may also have had localised egg lesions setting up irritative foci but possibly these were small and following treatment resolved to become insignificant. The five patients who presented with seizures and had nothing to find on neurological examination, possibly had multiple widespread irritative foci and eggs in the tissue.

In these modes of presentation, *S. mansoni* and *S. haematobium* are therefore similar to Japonicum mentioned above with the exception of (4) the space occupying lesion requiring surgical intervention.

Authors who have analysed numbers of cases of cerebral bilharzia, and these latter are for the great majority Japonicum, have been able to group their cases into acute onset — under six months from exposure time, and chronic onset after six months. We have not been able to do this but instead have used the onset and clinical picture to identify an acute, a subacute or a chronic type of case. Our first two cases were acutely sick, whilst the next three had a more

subacute onset with symptoms developing over a longer period, and the last three cases were all chronic in symptomatology and duration of symptoms.

We had one further case that is of interest because this patient was asymptomatic.

Case No. 9 Asymptomatic Cerebral Bilharziasis

A 63 year old patient was admitted to hospital on the 10th January, 1958. The previous September and October he had suffered from two bouts of pneumonia, but these had cleared up and his chest X-ray had remained normal. One week prior to his admission to hospital, he had developed a left hemiplegia. Arteriography had shown a right parietal mass and the diagnosis of primary carcinoma of the lung with cerebral secondaries was made; bronchoscopy, however, revealed no abnormality. A right parietal flap was turned and immediately the dura was opened a glazing of the pia and arachnoid was noted. It was felt that this was the neoplastic area for which the search was being made and a biopsy was taken. Examination of the section showed fibrous tissue surrounding an ovum of bilharziasis, though the type was uncertain. The patient continued downhill and died four weeks later. At post-mortem a metastatic carcinoma of the right parietal region underlying an area of bilharzial sclerosis was noted. A primary growth was demonstrated in the lung. There was no history suggesting that the bilharziasis had ever caused him any trouble.

Summary

Nine cases of cerebral bilharziasis have been presented — one of which was asymptomatic and eight had evidence of active brain involvement. The patients were non immune subjects who had an acute exposure to bilharzia in an endemic area. The commonest mode of presentation was seizures although a variety of neurological manifestations occurred. All responded well to antibilharzial treatment.

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