The neurocysticercosis project in Atteridgeville - Mamelodi townships

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Abstract **The incidence and prevalence of neurocysticercosis in South Africa are unknown. A hospital-based prospective study to determine the incidence of neurocysticercosis was therefore undertaken. A research questionnaire and strict inclusion and exclusion criteria were used. Apart from determining the incidence, our other aims were to determine the sources of infection and routes of transmission, evaluate therapeutic programmes and, on the basis of our findings, develop prevention programmes.**

We found that it was impossible to determine the sources of infection and routes of transmission. When strict selection criteria were applied the number of patients (13) was significantly smaller than the 58 patients in an earlier pilot project. The implications of the findings for incidence surveys are discussed.

The implications of the enzyme-linked immunosorbent assay (ELISA) of serum and cerebrospinal fluid for diagnosis are discussed. The effectiveness of praziquantel was confirmed, and therapeutic approaches and preventive measures based on our findings are suggested.

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Following a pilot neurocysticercosis project conducted by our Neurology Department in Atteridgeville and Mamelodi townships, we decided to undertake a full project to study the problem. Kalafong Hospital is situated in Atteridgeville and provides all the inpatient care for the Atteridgeville and Mamelodi suburban areas of Pretoria. The total population of the two areas was 233 260 according to the 1980 census. The objectives of our full project were: (*i*) a prospective study to determine the incidence of neurocysticercosis in Atteridgeville - Mamelodi townships; (*ii*) to determine the sources of infection and routes of transmission; (*iii*) to evaluate the effectiveness of therapeutic programmes; and (*iv*) to develop the basis for prevention programmes.

We felt that the results of the project might contribute to the debate raised in Campbell's[1] editorial, 'Another sinister silent epidemic?', in which a plea was made for efforts to determine how great a problem neurocysticercosis was and how best to prevent it.

The incubation period, i.e. the period between the lodgement of oncospheres and the development of symptoms, is said to average 4 - 5 years with a range of 1 year to 30 years.[2] This influenced our choice in respect of the minimum period of residence in the two townships necessary for inclusion in our project.

We believe that the design of prevention programmes depends on accurate determination of the sources of infection, modes of transmission and the magnitude of the problem. These considerations therefore also influenced the design of our project.

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Patients and methods

Patients

Index case finding entailed monitoring of the computed tomographic (CT) brain-scans of symptomatic patients at Kalafong Hospital. The scans were accepted for the project if they satisfied the criteria laid down by Sotelo *et al.*[3] for the diagnosis of neurocysticercosis.

Active disease is characterised by arachnoiditis, hydrocephalus secondary to meningeal inflammation, parenchymal cysts, brain infarction secondary to vasculitis, mass effect due to a large cyst or clumps of cysts, intraventricular cysts and spinal cysts.

Inactive disease is characterised by parenchymal calcifications and hydrocephalus secondary to meningeal fibrosis. For the purposes of our study the following CT patterns were regarded as indicative of active neurocysticercosis: (*i*) rounded areas of low density that were not enhanced by the administration of contrast medium (viable cysticerci); (*ii*) hypodense or isodense lesions surrounded by oedema and ring-like or nodular enhancement after the administration of contrast medium (acute encephalitic phase of parenchymal neurocysticercosis); and (*iii*) diffuse brain swelling associated with small lateral ventricles and multiple nodular ring-like areas of enhancement after the administration of contrast medium (cysticercotic encephalitis).

The following were then done for each patient: (*i*) a full history was taken; (*ii*) a full clinical examination was done; (*iii*) a research questionnaire was completed; (*iv*) enzyme-linked immunosorbent assays (ELISAs) (immunoglobulin G (IgG)) of the serum and cerebrospinal fluid (CSF) were performed. This was done on the basis of Rosas *et al.*'s[4] statement that the diagnosis of neurocysticercosis can only be conclusive with the aid of CT and CSF analysis; (*v*) stools were examined for parasites and eggs; and (*vii*) routine laboratory investigations were undertaken, including assessment of CSF pressure, microscopy, chemistry, culture and sensitivity; full blood count with differential count and measurement of erythrocyte sedimentation rate; serum microanalysis II, serum glucose assessment, serum tests for syphilis and tests for syphilis in CSF where indicated; and urinalysis. Other tests, e.g. biopsy, were done where indicated, as were tests for collagen disease and malignancy.

The research questionnaire

The research questionnaire was designed to include patients born or permanently resident in Atteridgeville or Mamelodi townships for a period of at least 18 months. This was to accommodate the shortest incubation period. It aimed to establish whether the sources of their meat/food were solely the Atteridgeville/Mamelodi/Pretoria municipal areas, and whether herbal medication from traditional doctors (witch-doctors) was a possible source of infection. In addition, it set out to determine whether the infection originated within the family, whether the patients ate pork, and whether their

cooking or roasting of meat was thorough and how their vegetables were prepared.

Treatment

All patients whose CT scans showed active disease were treated for 14 days with oral praziquantel (pyrazino-isoquinolone) at 50 mg/kg body-weight/day, divided into three equal doses. Symptomatic treatment, such as anticonvulsants, steroids, mannitol, the shunting of CSF and other surgical procedures were given as required. Repeat CT scans were done after completion of the initial course of praziquantel treatment. The reason for the early repeat CT was to avoid defaulting and extra expenditure.

Results (Table I)

The clinical features and results of the ELISAs on blood and CSF are shown in Table I. The pre-treatment CT scans and the results of treatment are shown in Table II. The ages of the patients ranged from 10 years to 55 years with an average of 32,8 years. Nine (69,2%) of the patients presented with epilepsy, 2 (15,4%) with psychiatric disorders, 1 (7,7%) with headache and 1 (7,7%) with headache followed by stupor. Ten (76,9%) patients had active neurocysticercosis (viable cysticerci and/or the acute encephalitic phase of parenchymal neurocysticercosis) on their CT scans and 3 (23,1%) inactive disease.

TABLE I.
Clinical data and ELISA results

Patient	Age (yrs)/ sex	Clinical presentation	ELISA	
			Blood	CSF
1	49/M	Epilepsy	High positive	Mid-range positive
2	28/M	Epilepsy	Low positive	Mid-range positive
3	25/M	Epilepsy	Low positive	Low positive
4	22/F	Epilepsy	Low positive	Negative
5	38/M	Headache	Low positive	Negative
6	38/M	Headache and stupor	Mid-range positive	Mid-range positive
7	10/M	Epilepsy	Mid-range positive	Negative
8	40/M	Disorientation	Low positive	Negative
9	43/F	Epilepsy	High positive	High positive
10	28/F	Psychiatric disorder	Low positive	Negative
11	20/M	Epilepsy		
12	55/M	Epilepsy		High positive[6]
13	30/F	Epilepsy	High positive	Low positive

As shown in Tables I and II, the ELISA in serum[5] was positive in all 11 patients with neurocysticercosis. The degree of positivity ranged from low to high. In the patient with inactive disease in whom the assay was done, it was mid-range positive.

TABLE II.
Pre-treatment CT scans and results of treatment

Patient	Pre-treatment CT scans	Results
1	Active* and inactive†	Completely healed with calcifications
2	Active and inactive	Completely healed with calcifications
3	Active and inactive	Completely healed with resorption of cysts
4	Active and inactive	
5	Active and inactive	
6	Active and inactive	Hydrocephalus remitted spontaneously
7	Inactive	Healing with calcifications
8	Active and inactive	Healing with involution and calcifications
9	Active with hydrocephalus/inactive areas	Still awaiting repeat CT
10	Hydrocephalus/inactive areas	Ventriculoperitoneal shunt done
11	Inactive	Still awaiting repeat CT
12	Active and inactive	Healing with involution and calcifications
13	Active and inactive	Healing with involution and calcifications

* Cysts, meningitis/arachnoiditis and their complications.
† Calcifications.

Of the 10 patients with active disease on whom ELISAs of the CSF were done, 7 (70%) were positive and 3 (30%) negative. In both patients with inactive disease, the results were negative.[7]

Stool examination was negative for parasites or eggs (ova) in all patients. All other special examinations had normal results except for a biopsy of a subcutaneous nodule in patient 1 which revealed cysticercosis.

The results of the questionnaire showed that the following possible sources of infection — traditional doctors,[8] private slaughter, inadequate cooking or boiling and family spread — were not confirmed by the answers, and that the difficulty in pinpointing the sources of infection was illustrated by the many points at which infection could have taken place, outside and inside the Pretoria/Atteridgeville/Mamelodi areas.

Results of treatment (Table II)

For reasons beyond our control the time interval from completion of treatment to repeat CT ranged from 1 day to 4½ months. As shown in Table II, all patients with active neurocysticercosis on whom repeat CT was performed, showed healing; cysts were either in various stages of involution, or being replaced with calcifications. Patient 2 had his repeat scan 2 months after his first and 34 days after completing his course of praziquantel. As shown in Figs 1 and 2 the cysts have disappeared and one has been replaced by calcifications. Only patient 10 needed a ventriculoperitoneal shunt. In patient 1, active neurocysticercosis had been present for about 8 years. His lesions resolved promptly on treatment with praziquantel.

Patient 6 presented with headache and then gradually developed stupor which, on CT, proved to be due to hydrocephalus involving mainly the lateral and third ventricles. The clinical state improved and reversed within 48 hours. Repeat CT showed that the hydrocephalus had resolved spontaneously. As the ELISAs were mid-range positive in both the serum and CSF, the patient was given full specific treatment.

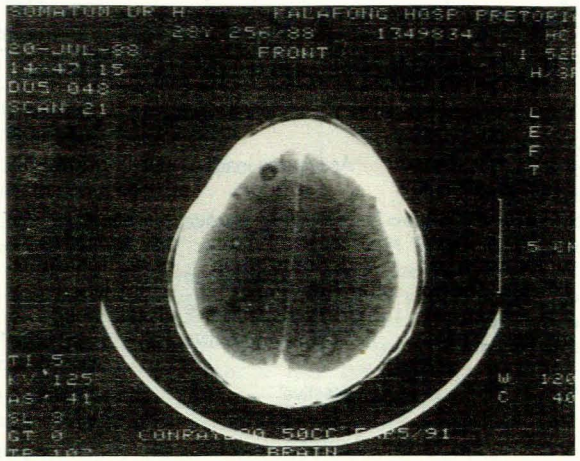

FIG. 1

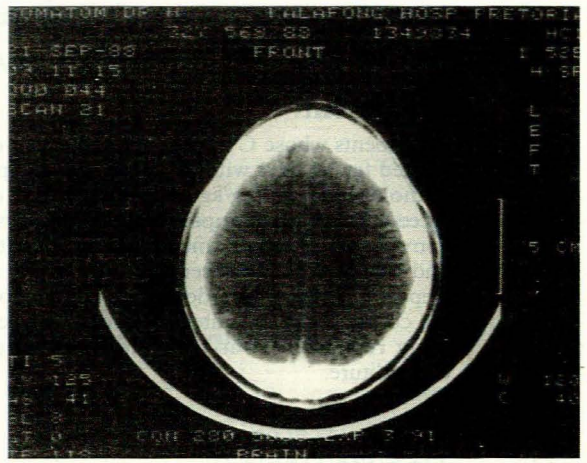

FIG. 2

Discussion

Effectiveness of therapeutic programmes

As shown by our results, all patients with active neurocysticercosis whose CT scans were repeated underwent healing of the cysts following treatment with praziquantel. The effectiveness of praziquantel has been demonstrated on innumerable occasions since its first reported successful use by Robles *et al.*[9] in 1979.

The disease can remain active for many years as in patient 1 and during this period may spread to the CSF pathways[10] and spinal cord.[11] Prompt and full treatment will prevent this. Although stools in all patients were negative, up to 53% of patients with cysticercosis have been reported to have intestinal taeniasis.[11] As these patients are an epidemiologically important link in the transmission chain of cysticercosis, their treatment is of paramount importance. Epilepsy was the commonest presenting clinical feature in our patients as in most series of neurocysticercosis patients. It is believed that early and adequate treatment with praziquantel may prevent permanent epilepsy.[1]

Sources of infection and routes of transmission

As mentioned in the results, all the patients had been in and out of their areas of residence on innumerable occasions; this makes pin-pointing of the sources of infection impossible.

Incidence of neurocysticercosis in the areas

The 13 patients, out of a population of 233 260, represent an incidence of 0,0557/1 000 population. For economic, social and other reasons the census figures are not accurate and consequently the incidence can, at best, be regarded only as a rough estimate.

The basis for prevention programmes

Prevention programmes have to take the triad of agent (parasite), host and environmental conditions into consideration. Ingestion of food contaminated with ova is believed to be the most common cause of neurocysticercosis.[12] Eggs may stay alive in grasslands for as long as 8 months and in sewerage for 2 weeks although exposure to desiccation kills them rapidly.[13] Whether praziquantel is ovicidal for *Taenia solium* and other cestode eggs has not been clearly established in man.[13] The patient harbouring the adult worm is more dangerous than the infected pig because he passes eggs in his stools. To break the chain of neurocysticercosis infection, he should be given full specific treatment. The one possible exception to treatment is in the case of patients with the encephalitic form of neurocysticercosis.[10]

It has been recommended that mass diagnosis of the population and treatment of all infected persons will break the chain of transmission.[13] Whether our country has sufficient manpower and can bear the cost of such a project are doubtful. Given the problem of pin-pointing the sources of infection, the following preventive measures should be given serious consideration.

Educational programmes on television, radio, in newspapers and other media have the following aims: to teach the public about the disease: its cause, sources of infection, routes of transmission and its prevention. Basic hygiene and thorough cooking and roasting of pork and vegetables are emphasised.[14]

Present public measures should be continued and intensified to make sure that infected meat with viable cysticerci does not reach the consumer. According to the meat-board, light to moderately infected pork was kept at –20°C for 3 days to kill the cysts. This has been found to be effective elsewhere.[14] Heavily infected carcasses were condemned and destroyed.

Other public health measures should include: (*i*) prevention of the use of night soil as a fertiliser; (*ii*) provision of sanitary facilities; and (*iii*) adequate treatment of sewerage to prevent infection of pigs and cattle.[13]

It is hoped that the above measures will help to reduce the spread of the 'sinister silent epidemic'.

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