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Neurocysticercosis – A Review of 231 Cases

Summary: Two hundred thirty-one cases of neurocysticercosis are reviewed. Diagnosis was established by cerebral computed tomography during a seven-year period (1983–1989). One hundred and fourty-four (62%) presented with symptom-related disease (symptomatic neurocysticercosis and in 87 the diagnosis was incidental (asymptomatic neurocysticercosis). In symptomatic neurocysticercosis the parasitosis was considered inactive in 115 cases and active in 29. Seizures occurred in 135 patients (96% of the symptomatic neurocysticercosis). In the active form we also found: meningitis (n = 15), intracranial hypertension (n = 12), hydrocephalus (n = 10) and arteritis (n = 2). Treatment included praziquantel (n = 21), albendazol (n = 4), dexamethasone (n = 18) and surgery (n = 10).

Zusammenfassung: *Neurozystizerkose – Übersicht über 231 Fälle.* Im Zeitraum von sieben Jahren (1983–1989) wurden mittels Computertomographie des ZNS 231 Fälle von Neurozystizerkose gesichert. In 144 Fällen (62%) handelte es sich um symptomatische, in 87 Fällen um asymptomatische Formen, die zufällig entdeckt wurden. In 115 der symptomatischen Fälle wurde die Parasitose als inaktiv und in 29 als aktiv beurteilt. 135 Patienten, das heißt 96% der Kranken mit symptomatischer Neurozystizerkose, litten an Anfällen. Aktive Formen wurden außerdem in 15 Fällen als Meningitis, in 12 mit intrakranieller Hypertension, 10 mit Hydrozephalus und zwei mit Arteriitis manifest. Therapeutisch wurde in 21 Fällen Praziquantel, in vier Fällen Albendazol, in 18 Fällen Dexamethason eingesetzt, und 10 Patienten wurden operiert.

Introduction

Neurocysticercosis is the most frequent parasitic disease of the central nervous system [1]. The biologic cycle of *Taenia solium* is rather simple and exclusive for its sole vectors are man, the final host, and the pig, the intermediate host [2].

The most serious form of the disease results from parasites in the brain or in the eyes, muscular dissemination being almost asymptomatic. Although epilepsy is the most common clinical presentation, signs and symptoms may be protean and depend on the number, evolution and location of the cysticerci and the host's immunological reaction [2, 3].

The introduction of cerebral computed tomography (CT) as a routine procedure for the study of cerebral diseases has proved to be a major development in the diagnosis of neurocysticercosis [4]. Classic descriptions [5] gave way to a rational clinico-radiological classification [6] and therapeutic strategies, both medical [7, 8] and surgical [9–11], that could be programmed and monitored. Another important development has been the discovery of efficient drugs in the treatment of the active phase of the disease, such as praziquantel [12] and albendazol [13].

Before the advent of CT, neurocysticercosis was considered a rare parasitic disease in Portugal. The Hospital Geral de Santo António started using routine CT for assessing neurological diseases in 1983 and, since then, the endemic nature of neurocysticercosis in the north of the Country has been suspected [14, 15]. This study reports our experience with 231 patients as far as clinical, radiological and therapeutic aspects are concerned.

Patients and Methods

The Hospital Geral de San António is a central hospital serving a population of 1,700,000 inhabitants, both rural and urban, including a part of the district of Oporto and the north inland. Up to 1989, 231 cases of neurocysticercosis were diagnosed, corresponding to 0.66% of the 35,000 CT's performed by the Department of Neuroradiology. Until the end of 1985 neurocysticercosis identification was the result of retrospective research [16], which became prospective thereafter. The radiological diagnosis was confirmed by at least one of the authors. Patients suffering from active neurocysticercosis have been examined more thoroughly and their management, either clinical or surgical, has been monitored by clinical examination and serial CT's. The following radiological diagnostic criteria were adopted, partly based on *McCormick* [17], as mentioned elsewhere [15].

True neurocysticercosis: If a) several (three or more) punctiform calcifications, mainly cortically located, measuring a few millimeters to 1 cm were found, or b) two calcifications with the same characteristics separated from each other by more than 3 cm, or c) combinations of calcifications and cystic lesions, with or without peripheral enhancement by contrast media or d) a single cyst or a single typical calcification but with parasitic calcifications in the muscles, or e) a single cyst, seldom a granuloma, or several cysts which disappear either spontaneously or following specific therapy. Some of these cases have been substantiated by histological or serological evidence. All other possible etiologies were excluded.

Probable neurocysticercosis: Whenever there was a) a single calcification with the above-mentioned characteristics upon exclusion of other causes; b) after excluding other etiologies, chronic meningitis with eosinophils in the cerebrospinal fluid (CSF), with or without hydrocephalus and followed or not by

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Table 1: Clinicoradiological classification of 231 cases of neurocysticercosis.

	No.
Symptomatic neurocysticercosis	144 (62%)
Active	29*
with epilepsy	21
with meningitis	15
with hydrocephalus	10
with intracranial hypertension	12
with arteritis	2
Inactive	115*
with epilepsy	113
with hydrocephalus	4
with meningitis	1
Asymptomatic neurocysticercosis	87 (38%)

* In some patients more than one manifestation was observed.

other changes in the CT or in magnetic resonance imaging (MRI). As there were no routine immunological tests of neurocysticercosis available in Portugal, these criteria were not taken into account. Nevertheless, a particular case studied immunologically abroad will be mentioned.

A clinicoradiological classification (Table 1), largely adopting the one proposed by *Sotelo* et al. [6], has been established. Neurocysticercosis has been deemed as active whenever the CT showed cysts (parasites considered biologically viable) with or without a small perilesional inflammatory ring visible in either a plain or contrast-enhanced scan. The diagnosis of meningitis was made when there was a CSF inflammatory profile with or without signs of meningitis; the diagnosis of intracranial hypertension was made whenever there were the usual symptoms (headache and papilloedema); arteritis was substantiated by cerebral angiography. Any patient who suffered from active neurocysticercosis could present with one or more of these syndromes. Asymptomatic neurocysticercosis has been linked with the neuroradiological finding of one or more calcifications as above described in patients studied for cerebrovascular pathology or cranial trauma.

Results

The relative distribution of the different forms of neurocysticercosis is summarized in the Table 1. One hundred twenty-four (53%) patients were female and 107 (47%) were male. One hundred twenty-eight (55%) cases were classified as true neurocysticercosis and 103 (45%) as probable neurocysticercosis. The mean age, at the first manifestation of the disease (144 cases), was 30 years.

Epilepsy was an almost constant feature (96%) in the 144 symptomatic cases, either as generalized tonic-clonic (41%) or partial, mainly simply motor epilepsy (59%) but frequently with secondary generalization (39%).

Intracranial hypertension appeared in 11 patients either due to the mass effect of multiple cysts together with edema and inflammation, or to hydrocephalus, or to a combination of both (Figure 1). In its active forms it has been impossible to accurately pinpoint the mechanism of hydrocephalus: in five cases both CT and the clinical findings strongly suggested the existence of intraventricular cysts, but neither cysternography nor MRI demonstrated them. Two patients suffered from arteritis which, in one case, was further complicated by thrombosis of the middle cerebral artery.

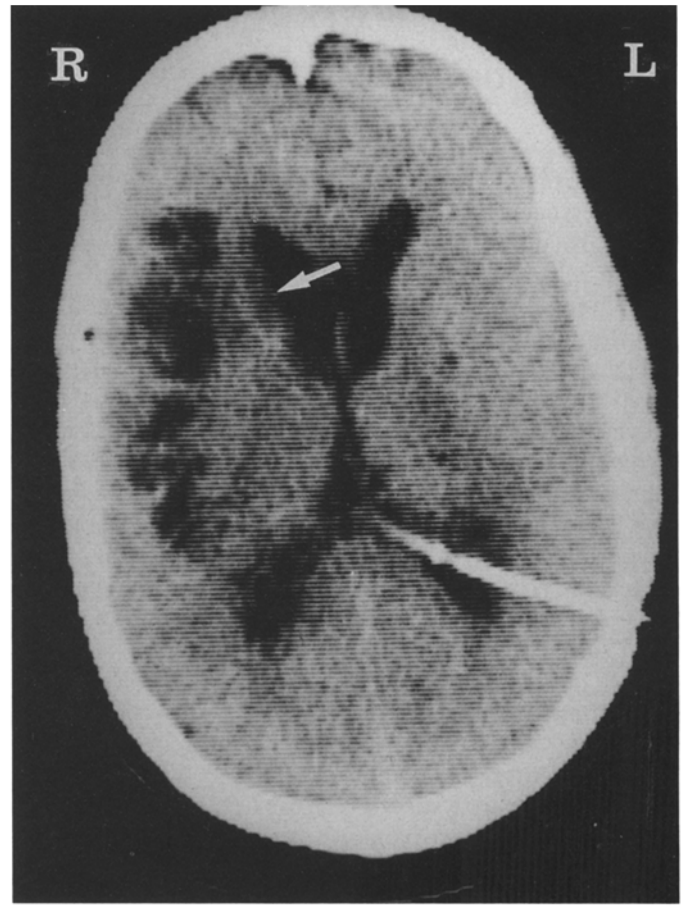

Figure 1: Cerebral CT-scan: multiple cysts in the right sylvian fissure. Infarction of the right caudate nucleus and internal capsule (arrow). Ventricular shunt *in situ*.

CSF was studied in 53 patients (23%). In 21 cases the cyto-chemical composition of CSF was abnormal. In the active forms, which were studied more systematically (23/29), 13 patients presented an inflammatory profile (five with eosinophils), but only one had clinical meningitis.

Parasitic calcifications in the muscles were only sought in 74 cases (32%), of which 29 (34%) were positive.

The 29 patients with active neurocysticercosis were treated with praziquantel (n = 21), albendazole (n = 4), dexamethasone (n = 18), ventriculo-peritoneal shunts (n = 8), or excision of the cysts (n = 2). The average follow-up period was 3.5 years (1–8 years) and the results were classified as follows: cured with or without epilepsy (n = 12); improved, those who had had surgery even when normal from a neurological standpoint (n = 8); in evolution, whenever cysts were permanent or a racemous form was supposed to exist (n = 2); deceased (n = 3). Four patients were lost to follow-up. In the inactive but symptomatic form 62% of the patients had complete seizure control, with 12% free of epileptic drugs.

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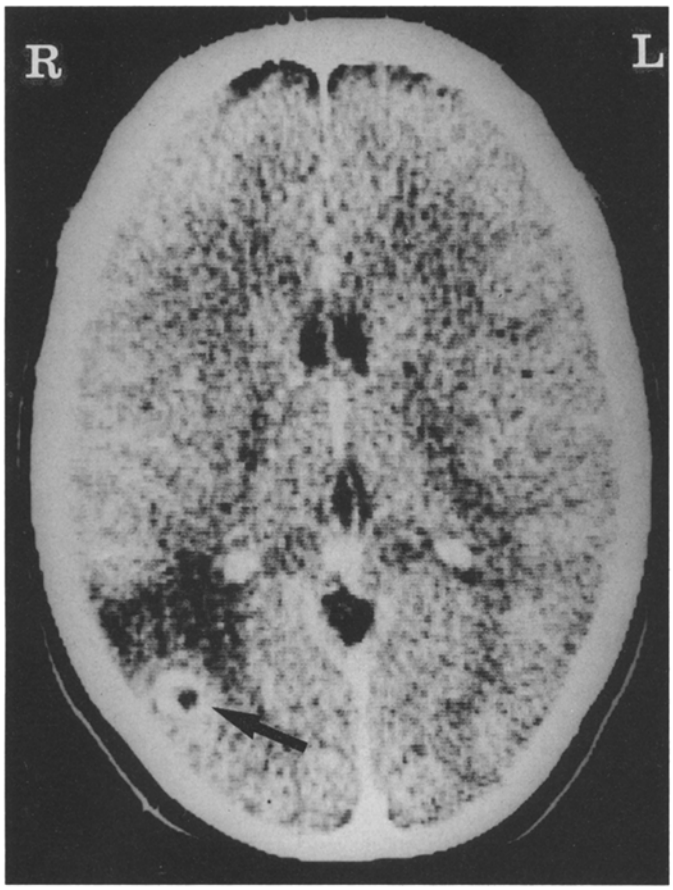

Figure 2: Cerebral CT-scan after intravenous injection of contrast medium: cysticercotic granuloma (arrow) histologically confirmed.

Discussion

Two hundred thirty-one cases of neurocysticercosis were studied. The diagnosis was established by CT, the "gold standard" routine test for neurocysticercosis [4, 6, 18–21], which has increased diagnostic accuracy so that in endemic areas the incidence increased two- to fivefold [15, 19]. The CT diagnosis is easy, provided there are multiple and typical calcifications associated (active forms) or not (inactive forms) with cysts in patients coming from endemic areas.

MRI has been considered an important tool in neurocysticercosis, namely in the meningeal and ventricular location of the cysts [22–26]. In our limited experience of five cases of presumed intraventicular cysts the MRI was non-contributory.

The x-ray of the muscles of thighs showed parasitic calcifications in 34% of 74 cases, higher than quoted in other studies [6,19]; this might occasionally be useful when the CT is inconclusive.

As anticipated, epilepsy, the main feature of symptomatology in neurocysticercosis [2], appeared in 96% of our patients and could be successfully controlled in two thirds by antiepileptic drugs. Therefore, in the north of Portugal, as well as in other endemic areas [27], neurocysticercosis is a frequent cause of epilepsy in young adults.

An important and unique aspect in our series was the discovery that 87 cases (38%) were not only inactive but also asymptomatic, incidentally in patients studied for cerebrovascular disease or cranial trauma. *Minguetti* and *Ferreira* [19], also in a radiological series, found only 11 asymptomatic cases (6%). In a study of 100 patients, *Zini* et al. [28] describe 11 as "incidental findings" in head trauma patients. This was already known from autopsy data [29] but had never been emphasized in predominantly clinical series [6–8, 19, 30] – a fact that has twisted the spectrum of the disease by favouring the most serious cases.

Both the asymptomatic and the inactive symptomatic forms (in which the parasite's viability spontaneously disappeared) represented 87% of the 231 cases, whereas the active forms – the most frequently diagnosed before the advent of CT due to their neurosurgical aspects – represented the remaining 13%. This means that the spontaneous death of the parasite is the rule and in more than one third of the cases there are no clinical sequelae.

The differential diagnosis of single cysts or granuloma is difficult and normally calls for an exploratory biopsy [31–33] when immunological tests are negative, which can occur with a normal CSF. Several investigators [2, 6, 18, 21, 33, 34] do not consider these tests as important as other authors do [35], although they recognize their contribution to a greater accuracy in diagnosis. A negative test in patients with calcifications or granuloma in the appropriate clinical and epidemiological setting does not exclude neurocysticercosis [6, 33]. In one of our patients who presented an isolated lesion suggesting a cysticercotic granuloma, the enzyme-linked immunosorbent assay in the CSF was negative (*Knobloch*, Bernhard-Nocht-Institut, Hamburg, Germany) and led to the excision of the lesion (Figure 2). Other recent immunological techniques will hopefully allow the broad use of highly sensitive and specific testing procedures [36].

Since *Sotelo* et al. [7] definitely established that praziquantel is effective in destroying cerebral parasitic cysts, this drug has been largely used. Our experience, although limited, has confirmed its efficacy. In 52% of the 29 active forms, the CT performed three months after completion of the treatment showed that cysts had disappeared or had turned into granulomas. However, praziquantel only acts upon parenchymatous cysts and is useless in intraventricular or meningeal cysts. Albendazole, a newly introduced drug with an efficacy equal to or higher than praziquantel [37], is less expensive and probably acts upon intraventricular cysts [38]. The malignant or complicated forms [39], as well as those in which inflammation is an important feature, may benefit from the use of a corticosteroid therapy. Our single case of cerebral infarction occurred in such a patient two weeks after the end of praziquantel therapy and when

dexamethasone had been discontinued. Cysticercotic arteritis is a rare complication [40] and presumably can be prevented by a long-lasting corticosteroid therapy.

Surgical strategy depends on the clinicoradiological framework. Thus, in the presence of a hydrocephalus, a ventricular shunt is advised [10, 41], intraventricular cysts should be approached according to each case and a giant cyst or a mass-effect conglomerate of cysts should be excised [11]. However, in our series the main neurosurgical intervention was the ventriculo-peritoneal shunt for hydrocephalus.

In conclusion, the endemic nature of neurocysticercosis in the north of Portugal was established with the introduction of CT. The symptomatic forms predominate, as expected in a hospital based study, and epilepsy was an almost ever-present feature of these forms. However, it should be emphasized that more than one third of the cases was asymptomatic.

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