

# Neurocysticercosis at UTH of Kara: Epidemiological, Clinical, Diagnostic, Therapeutic and Evolutive Aspects

Léhleng Agba<sup>1</sup>, Lihanimpo Djalogue<sup>2</sup>, Abide Talabewi<sup>3</sup>, Nyinèvi Komla Anayo<sup>4</sup>, Kokou Mensah Guinhouya<sup>3</sup>, Massaga Dagbe<sup>5</sup>, Adama Mawuliplimi Ephoevi-Ga<sup>3</sup>, Vinyo Kumako<sup>1</sup>, Damelan Kombate<sup>6</sup>, Komi Assogba<sup>3</sup>, Agnon Ayolola Balogou<sup>4</sup>

<sup>1</sup>Neurology Department, University Teaching Hospital of Kara, Kara, Togo

<sup>2</sup>Internal Medicine Department, University Teaching Hospital of Kara, Kara, Togo

<sup>3</sup>Neurology Department, University Teaching Hospital of Sylvanus Olympio, Lome, Togo

<sup>4</sup>Neurology Department, University Teaching Hospital of Campus, Lome, Togo

<sup>5</sup>Radiology Department, University Teaching Hospital of Kara, Kara, Togo

<sup>6</sup>Neurology Department, Regional Hospital Center of Kara, Kara, Togo

## Email address:

thierrielle@gmail.com (Léhleng Agba)

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**Abstract:** *Objective:* to determine the rate of NCC in hospital practice at the University Teaching Hospital of Kara and more specifically the socio-demographic characteristics, the different clinical and CT aspects of this affection as well as the evolutionary profile undergoing treatment. *Method:* a cross-sectional study was conducted at the University Teaching Hospital of Kara from January 1, 2018, to December 31, 2022. Outpatients and inpatients who showed brain imaging signs of NCC were included in this study. *Results:* Forty-one (41) patients have been included, corresponding to an inpatient frequency of 0.72%. The patient mean age was 49.24 years (SD, 18.67 years) and 26 (63.41%) patients were male. Thirty-one (75.61%) patients presented with epileptic seizures and 15 (36.59%) patients reported headache. Calcification lesions were identified on 36 (87.80%) CT and cystic lesions were visualized on 14 (34.15%) CT. Ischemic stroke lesions were found on the CT scans of 5 (12.20%) patients. Praziquantel was the specific anti-parasitic drug used associated to corticosteroid to minimize inflammatory response. Improvement of the mains symptoms such as seizure and headaches were observed at the end of treatment. *Conclusion:* NCC is a real public health problem due to the polymorphism of symptoms and clinical signs, making its diagnosis difficult. From this study, mass screening of the population should be carried out, followed by sensitization of all segments of the population, from pig farmers to consumers.

**Keywords:** Neurocysticercosis, Epidemiology, Kara University Hospital, Togo, Sub-Saharan Africa

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## 1. Introduction

Neurocysticercosis (NCC) is the infection of the central nervous system (CNS) caused by *Taenia solium* (*T. solium*) larvae. It is the most common parasitic disease of the human CNS [1]. In low-income countries with a high prevalence of pig farming, this type of tapeworm exhibits an endemic evolution. NCC is one of the most significant causes of

epilepsy worldwide [2]. It can also be observed in industrialized countries, where it is most commonly due to immigration from endemic areas [3]. NCC should not be confused with “teniasis”. Understanding the life cycle of the tapeworm helps to differentiate between NCC and teniasis. When humans eat undercooked pork containing the worm cyst, the cyst matures in the intestine, releasing the eggs in the feces. Humans thus become the definitive host as they harbor the adult form of the tapeworm [4, 5]. This presence

of the adult form in the intestine is known as tapeworm teniasis. The eggs deposited by mature tapeworms in the intestine are expelled into the environment through the feces of the infected individual. These eggs can contaminate food, and when consumed in a contaminated meal, they undergo digestion, releasing oncospheres. These oncospheres then penetrate the intestinal wall, enter the bloodstream, and are transported to different organs within the human body. Once there, they encapsulate themselves with a protective layer, giving rise to the cystic form of the parasite [6, 7]. Upon ingestion of the parasite's egg, humans become an unintended host, disrupting the parasitic life cycle. The essential requirement for the cycle to proceed is the ingestion of the eggs (oncospheres) by pigs. [8]. NCC presents in two main forms depending on the localization of *T. solium* in the central nervous system. Parenchymal NCC occurs when the larvae are found in the brain parenchyma. When the larvae are located in the ventricles or sub-arachnoid spaces of both the brain and the medulla, the term extraparenchymal NCC is used. The clinical manifestations and prognosis of the disease differ according to the type of NCC [9, 10]. Extraparenchymal NCC has a very poor prognosis due to the acute hydrocephalus for which it is often responsible [11]. Clinical manifestations of NCC are polymorphic and depend on the number, size, stage, and location of the cysts and the immune response of an individual patient. As a result, the clinical presentations of NCC can range from asymptomatic to sudden death. The definitive diagnosis of NCC can only be made by visualizing the tapeworm in its cystic, larval, or calcified form through imaging examinations [12-15]. Diagnostic criteria are established by scientific societies and are continually updated to allow resource-limited countries, including those in sub-Saharan Africa, to diagnose this potentially fatal condition [16, 17]. In sub-Saharan Africa, where Togo is located, a number of studies on cysticercosis have been conducted [18-21]. However, these studies were mainly reviews relating to the biology of the parasite, clinical presentations, diagnostic criteria and ways of management. The few clinical studies reported were clinical cases. Of the studies of NCC conducted in North of Togo [18, 20], none on NCC has been carried out in a hospital setting. At a current time, when imaging methods for the diagnosis of NCC have certainly evolved, it seemed essential to conduct a cross-sectional study on this condition which is hidden under the aspect of other neurological diseases. The main goal was to determine the rate of NCC in hospital practice at the University Teaching Hospital of Kara and more specifically to determine the socio-demographic characteristics, the different clinical and CT aspects of this affection as well as the evolutionary profile undergoing treatment.

## 2. Patients and Methods

### 2.1. Center of Study

The current study was conducted at the University Teaching Hospital of Kara (UTH-Kara). UTH-Kara is

located in Kara city, in the north of Togo, 430 km from the capital, Lome, a city in the south of the country. The Neurology Department of UTH-Kara is not individualized and has 2 sections, the consultation section and the hospitalization section. The Neurology Department does not have its own hospitalization room. It is integrated into the Department of Medicine and Medical Specialities and shares the same beds and hospitalization rooms with the other services of this department.

### 2.2. Method and Population of Study

It was a descriptive cross-sectional study with longitudinal collection conducted from January 1, 2018, to December 31, 2022 (5 years). Were included in this study, both outpatients and inpatients who showed brain imaging signs of NCC, using the revised 2017 diagnostic criteria of Brutto [16]. Immunological tests, specifically Electro-Immuno-Transfert-Blot (EITB), were not available either at UTH-Kara or in private hospitals during the study period. The diagnosis was made when the brain CT scan showed spontaneously hyperdense punctiform lesions with peripheral hypodensity or cystic lesions with annular contrast, also associated with peripheral hypodensity corresponding to reactional edema. For each patient diagnosed, a soft tissue x-ray (arms, thighs, calves), as well as a fundus examination and a dermatological consultation were performed to look for other localizations. Praziquantel was the specific drug used for all patients. This treatment was given according to a protocol spread over 20 days on 3 repeated courses with an inter-cure break of 40 days. Evaluation of treatment efficacy was monitored with the most frequent symptoms and signs, except for the elements that were part of the diagnosis of stroke. Surgical indications were established for the management of extraparenchymal forms but, could not be performed because of the parents' lack of financial means.

### 2.3. Data Collection

Data were collected on a pre-established questionnaire of 89 points including the following items: socio-demographic data, personal and family history of the patient, data from the clinical examination, results of supportive examinations, the evolutionary character undergoing treatment.

### 2.4. Statistical Analyses

Statistical tests were carried out with epi info software (version 7.2.5) and the threshold for statistical significance was set to  $p < 0.05$ . The chi-square or Fisher's exact test was used to compare categorical variables, in compliance with their conditions of use. Quantitative variables were compared using Student's t test.

### 2.5. Ethics

An informed consent was received from each patient before recording of data, which was done in total confidentiality. The local ethics committee (approval number 0127/2022/FSS/UK/Kara) as well as the national ethics committee gave their approval for this study.

### 3. Results

From Jan 1, 2018 to Dec 31, 2022, 4123 new consultations were performed by the neurology department and 1577 new patients were hospitalized on behalf of neurology. During this period, 41 diagnoses of NCC were made both in consultation and inpatients, corresponding to a hospital frequency of 0.72% and a hospital prevalence of 0.14% per year.

#### 3.1. Sociodemographic Features

**Table 1.** Sociodemographic Features of the Study Population.

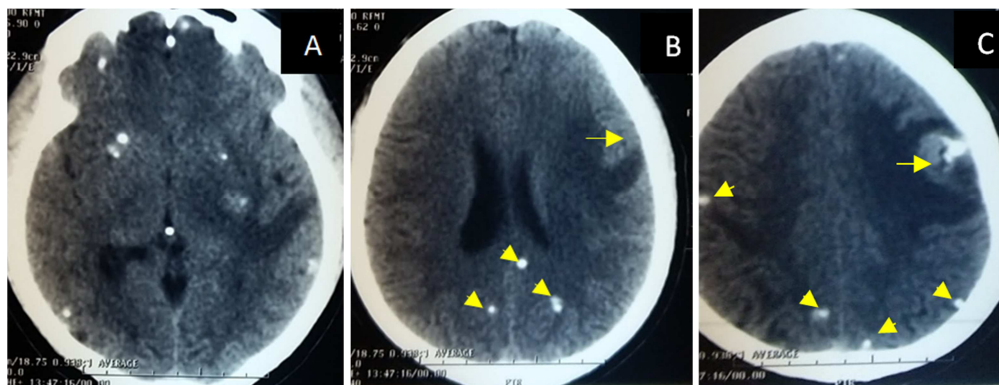
		Number (n)	Percentage (%)
Sex	Male	26	63.41
	Female	15	36.59
Age groups	5-<25	4	10.53
	25-<45	9	23.68
	45-<65	14	36.84
	65-<85	10	26.32
	85-<95	1	2.63
	Public servant	13	31.71
Profession	Student	4	9.76
	Retailer	4	9.76
	Craftsman	15	36.59
	Retired	5	12.20
Way of diagnosis	Consultation	36	87.80
	Hospitalization	5	12.20

Twenty-six (63.41%) patients were male. The mean age

was  $49.24 \pm 18.67$  years with extremes of 9 and 90 years (IQ: 39-65). In terms of profession, 15 (36.59%) patients were artisans and 13 (31.71%) were civil servants. Other sociodemographic characteristics are reported in Table 1. Thirty-six (87.80%) diagnoses were made in consultation.

#### 3.2. Diagnostic Features

Thirty-one (75.61%) patients presented with epileptic seizures and 15 (36.59%) patients reported headache. Motor deficits and language disorders were also noted, especially in hospitalized patients (Table 2). All patients underwent a brain CT scan, which was the main ancillary diagnostic tool. Calcification lesions were identified on 36 (87.80%) CT and cystic lesions were visualized on 14 (34.15%) CT. Lesions were predominantly supratentorial in 39 (95.12%) cases and for this location, they were in cortical or subcortical position on 37 (90.24%) CT scans (Figures 1 and 2). Ischemic stroke lesions were found on the CT scans of 5 (12.20%) patients. Details of the imaging data are grouped in Table 3. Among the stroke patients (n=5), 3 (60%;  $p=0.014$ ) had a medical history of hypertension, 3 (60%;  $p=0.014$ ) were older than 60 years and 2 (40%) were younger than 25 years. The latter had no cardiovascular risk factors, both clinical and paraclinical. Soft tissue x-ray was performed in 34 (82.93%) patients, 2 (5.88%) of whom showed soft tissue calcifications (Figure 3).



**Figure 1.** Non-Contrast axial Head CT Scans Showing in (A): Multiple Brain Benign-Appearing Calcifications Without Associated Mass Effect both Cerebral Hemispheres; in (B): 3 Spontaneous Calcifications in both Occipital lobes and a left Frontal Hypodensity Which in (C): is Enhanced by Contrast Product.



**Figure 2.** Contrast Axial CT Scan of Head Showing Variables Cyst with Scolex in One of Them.



**Figure 3.** Radiography of the Soft Parts of the Legs Revealing Diffuse Calcification in the Calves, the Lower Part of the Thigh.

**Table 2.** *Clinical Data.*

	Number (n)	Percentage (%)
CVRF and eating Habits		
Smoking	9	21.95
Hypertension	7	17.07
HIV+	2	4.48
Pig meat consumption	37	90.24
Admission complaints		
Headache	15	36.59
Intracranial hypertension	1	2.44
Seizures	31	75.61
Generalized tonic-clonic seizures	21	51.22
Absence seizures	3	7.32
Focal seizures	7	17.07
Motor deficits	5	12.20
Language disorders	3	7.32
Physical signs		
Hemiplegia	5	12.20
Aphasia	3	7.32
Disorder of consciousness	2	4.88

Note: CVRF: Cardiovascular risk factor; HIV: human immunodeficiency virus.

**Table 3.** *Paraclinical Features.*

		n (%)
CT scan (n=41)		
Aspects and location of NCC lesions	Calcifying lesions	36 (87.80)
	Cystic lesions	14 (34.15)
	Annular contrast enhancement	12 (29.27)
	Supra-tentorial locations	39 (95.12)
	cortical or subcortical lesions	37 (90.24)
	Basal ganglia	6 (14.63)
	Subtentorial location	
	Cerebellar lesions	5 (12.20)
	brain stem lesions	1 (2.44)
Type of NCC	Intraventricular lesion	3 (7.32)
	Parenchymal NCC	38 (92.68)
	Extraparenchymal NCC	3 (7.32)
Soft tissue x-ray (n=34)		
	Presence of calcifications	2 (5.88)
	Absence of calcification	32 (91.12)

Note: NCC: Neurocysticercosis.

### 3.3. Treatment and Prognosis Data

Praziquantel was the specific anti-parasitic drug used according to the usual protocol in all patients. Corticosteroid therapy was associated with this drug. Patients with a diagnosis of stroke received secondary preventive treatment with acetyl salicylic acid and management of risk factors in those who had them. Physiotherapy was the functional treatment in those with a motor deficit. The 3 patients (7.32%) with intraventricular localization did not benefit from surgical therapy and did not show signs of decompensation. At the end of the therapeutic protocol, an improvement of the headaches was observed in 11 (73.33%) of the 15 patients and an improvement of the seizures was noted in 24 (77.42%) of the 36 patients.

## 4. Discussion

The current study is a descriptive cross-sectional study on

NCC conducted at UTH-Kara, over a period of 5 years (from January 1, 2018, to December 31, 2022), with the main objective of describing the epidemiological, clinical, diagnostic, therapeutic and outcome aspects of this condition. The study has some limitations, including the size of the sample, which is not representative of the population, and the absence of all diagnostic tests, particularly immunological and histological. However, it allows to report results that can be used to develop projects for larger-scale studies.

### 4.1. Epidemiological and Sociodemographic Features

During the study period, 41 patients were included out of 4123 new consultants and 1577 new hospitalized for neurology, resulting in a hospital frequency of 0.72% and a hospital prevalence of 0.14% per year. The average age of the patients was  $49.24 \pm 18.67$  years. Son HJ [22] reported a higher mean age in Korea than this current study, which was  $54.5 \pm 12.7$  years. The mean age was lower in the study by

Bazan et al. [23] who reported a mean age of  $40 \pm 9.8$  years. Whatever the study, it is noted that young adults are more affected by this condition. This would reflect a neglect of food hygiene in this age group, which is the active population. Indeed, these young adults, called to work and obliged to eat outside most of the day, eat from street food vendors with substandard hygiene [24]. The low purchasing power of the population in poor countries would favor this risky food practice. Street foods are very popular in developing countries; however, very little statistical data exists on food-borne outbreaks attributed to street vended foods in developing countries. Nevertheless, the conditions of preparation and marketing of street foods are usually unacceptable [25, 26]. The male predominance seems to be common in the various publications [18, 19] as it was the case of our study with a male proportion of 63.41%.

#### 4.2. Diagnostic Features

The main symptoms leading to consultations in this study were epileptic seizures ( $n=31$ ; 75.61%) and headaches ( $n=15$ ; 36.59%). Indeed, parenchymal NCC has a multitude of clinical signs. Nevertheless, the reviewed literature reveals that epileptic seizures constitute the most frequent sign, especially in endemic countries. Although no pathognomonic clinical picture exists, in endemic regions adult-onset seizures are highly suggestive of neurocysticercosis [3, 15]. Headache is also a common symptom of NCC and may be present in a single condition, as confirmed by Rajshekhar [27] and Del Brutto [28]. Five (12.20%) patients and 3 (7.32%) presented with motor deficit and language impairment, respectively. This proportion of stroke was similar to that reported by Bazan [23] who mentioned a proportion of 10% and stated that this was the average proportion reported in the literature [29]. The strokes in the current study were all of the ischemic type, in agreement with the cases reported in the literature [2, 3, 23]. These patients had other cardiovascular risk factors that could explain the occurrence of this stroke event, as shown by the non-significance of the statistical test. However, in two patients aged less than 25 years, no etiology for the stroke was available other than NCC. The mechanism of stroke onset in NCC was explained by Callacondo as follows: “the vascular network of the brain are similarly affected by obstruction from cysticerci and inflammatory exudates; there may also be direct insult to the blood vessels themselves in the form of vasculitis” [30]. Accurate diagnosis of NCC is notoriously difficult and essentially based on histological examination. This histological confirmation of the parasite is not possible in most cases; therefore, diagnosis is usually based on neuroimaging and confirmed by serology. Available methods are problematic and implementation in resource-poor endemic is patchy [31]. Thus, in order to standardize the diagnostic approach, groups of experts have met several times to define the diagnostic criteria of the NCC. The first criteria were defined in 1996 [32]. These criteria have been revised, and the latest ones were established in 2017 [16].

#### 4.3. Treatment and Prognosis and Prevention

NCC treatment primarily involves medication, but surgical intervention may also be necessary. Pharmacologically, anticysticercal drugs are specifically employed for the eradication of parasites, in conjunction with symptomatic medications [33]. All patients of the study received medical treatment with Praziquantel. Corticosteroids were used as an adjuvant and patients who presented seizures were given antiepileptic drugs. Based on the literature, cysticidal chemotherapy is based on albendazole and/or Praziquantel, which are antihelmintics [34]. While Praziquantel can be given to pregnant women, pregnancy is a contraindication for albendazole [34]. Praziquantel was used at a dose of 15 mg/kg/day for 20 days in the current study. The last guidelines of 2021 [34] remind the duration of treatment which is between 10-14 days regardless of the molecule chosen between Praziquantel and albendazole. Knowing the high endemicity area in which our country is located and the very frequent pig breeding in the study area, it was decided to extend the duration of the treatment to 20 days. It should be remembered that, in some severe cases, the recommended treatment duration can be extended to 30 days with albendazole [2]. The latter molecule is also given at 15 mg/kg/day in two daily doses. It is recommended to combine corticosteroids with the specific treatment and 6 mg dose of dexamethasone was shown to reduce inflammation and the frequency of generalized seizures over 30 months following treatment [34]. In certain cases, a combination of two medications may be required to optimize healing, especially when a high number of parasites is observed on medical imaging [35]. According to the study reported by Garcia and Del Brutto in 2014, the combination of Albendazole and Praziquantel can be safely administered without increasing the side effects associated with tapeworm lysis [36]. To minimize side effects associated with parasite lysis, particularly an increase in intracranial pressure and seizures, studies have reported a beneficial effect of corticosteroid use and antiepileptic medications. This approach was implemented in all patients included in the current study [3]. A favorable outcome was observed in the current study. No surgical treatment was performed even though the indication was given in 3 patients. In fact, surgery is a recommended treatment for NCC in cases of intraventricular cysts, hydrocephalus [34]. Apart from case management of NCC, an important issue in this condition should be prevention. Butala thought that pig-keeping has been promoted as a route out of poverty in low- and middle-income countries [34]. Therefore, the significant increase in the number of pigs raised in rural communities has not been accompanied by efforts to assist small-scale farmers in maintaining the health of their pigs. Pigs are considered by poor resource farmers as requiring minimal inputs, and farmers perceive an opportunity in free-range pig farming within the community. However, to raise pigs in good health, significant veterinary inputs are necessary, including anthelmintic medications to break the transmission cycle of *T. solium* between pigs and

humans [37].

## 5. Conclusion

NCC is a real public health problem in low-income countries due to the polymorphism of symptoms and clinical signs making its diagnosis difficult. The existence of asymptomatic cases makes its hospital prevalence a poor indicator of this disease in our population where livestock farming is common and is done without regard to hygiene standards. Similarly, the eating habits of the active population, which is the most affected, favors the spread of this disease. From this study, it follows that immunological methods of diagnosis of cysticercosis should be made accessible and available, and mass screening of the population should be carried out, followed by sensitization of all segments of the population, from pig farmers to consumers.

## Conflict of Interest

The authors declare no conflict of interest related to this study.

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