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NATIONAL INSTITUTE OF MALARIOLOGY
PARASITOLOGY AND ENTOMOLOGY

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CLINICAL AND PARACLINICAL CHARACTERISTICS AND MAGNETIC RESONANCE IMAGING ON PATIENTS WITH NEUROCYSTICERCOS AND TREATMENT RESULTS OF ALBENDAZOLE AND PRAZIQUANTEL

Major: Parasitology and Entomology of Medicine
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MEDICAL PhD THESIS SUMMARY

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LIST OF THE SCIENTIFIC PUBLICATIONS OF THE AUTHOR THAT ARE RELATED TO THE THESIS

1. Dang Thi Thanh, Nguyen Quoc Dung, Nguyen Quang Thieu, Chan Quang Phuc, Nguyen Thi Thu Trang, (2022) The Clinical and paraclinical characteristics of cysticercosis in patients treated at the Clinical Department, National Institute of Malariology, Parasitology and Entomology, 2017–2020. *Journal of Malariology and Parasite Diseases control*, Vol. 4 (130). pp. 03-10.

2. Dang Thi Thanh, Ta Thi Tinh, Nguyen Quang Thieu, Chan Quang Phuc, Nguyen Quóc Dung, (2022), Compare the effectiveness and safety of albendazole and praziquantel in the treatment of cysticercosis., *Journal of Malariology and Parasite Diseases control*, Vol. 4 (130), pp. 11-22.

INTRODUCTION

Cysticercosis is an infection caused by larval cysts of the tapeworm *Taenia solium.* This infection occurs after a person swallows *Taenia solium* eggs. When people eat the taenia eggs, the eggs enter the intestines and develop into larvae. The larvae penetrate the intestinal wall and circulate to the brain, eyes, heart, musculature, etc., forming larval cysts and causing different symptoms depending on the location of the parasite. If Cysticercus cellulosae parasitizes in the brain, it will cause neurocysticercosis, which can lead to serious symptoms such as convulsions, epilepsy, and paralysis. Criteria for diagnosing neurocysticercosis include clinical symptoms, paraclinical tests such as histopathology, immune serology and diagnostic imaging. Histopathological examination or biopsy of cysts of Cysticercus cellulosae is often impossible or rarely possible. In cysticercosis, imaging diagnosis plays an extremely important role.

Treatment of neurocysticercosis is quite complicated, and the treatment course is long, and there are many interrupted treatment courses. Finding an effective and safe treatment regimen for treating neurocysticercosis is extremely necessary, especially using magnetic resonance imaging to evaluate treatment results. Based on the above practical and scientific requirements, we conducted research on the topic **"Clinical and paraclinical characteristics and magnetic resonance imaging in patients with neurocysticercosis and treatment results with albendazole and praziquantel"** with the following three specific goals:

1. Description of the clinical and paraclinical characteristics of neurocysticercosis at the National Institute of Malariology, Parasitology and Entomology (2017-2020).
2. Description of the image of cysts of Cysticercus cellulosae in the brain on magnetic resonance imaging, and the relationship with some clinical symptoms.
3. Evaluation of treatment results in patients with neurocysticercosis using two regimens albendazole and praziquantel.

Rationale of the doctoral thesis

Criteria for diagnosing neurocysticercosis include clinical symptoms, paraclinical tests such as histopathology, immunoserology and imaging diagnostics. Cranial MRI imaging diagnosis in cysticercosis is studied more thoroughly. At the same time, the

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treatment regimen for neurocysticercosis is evaluated, and magnetic resonance imaging is used to evaluate treatment results. Currently in our country, there are very few studies examining the results of neurocysticercosis treatment using MRI images.

New contributions of the doctoral thesis

- The study described in detail the image characteristics of cysts of Cysticercus cellulosae in patients with neurocysticercosis who came for examination and treatment at the National Institute of Malariology, Parasitology and Entomology in the years 2017-2020.

- The study evaluated the treatment results of patients with neurocysticercosis when using two treatment regimens with albendazole and praziquantel at the National Institute of Malariology, Parasitology and Entomology as a basis for modifications of Guidelines for diagnosis and treatment of neurocysticercosis in Vietnam.

Structure of the doctoral thesis

The thesis has 126 pages, including sections: Introduction (2 pages), Literature Review (36 pages), Research Objects and Methods (22 pages), Results (30 pages), Discussion (32 pages), Conclusion (3 pages), Recommendations (1 page). The doctoral thesis has 28 tables, 24 figures, 12 charts and 111 references (English and Vietnamese).

CHAPTER I. LITERATURE REVIEW

1. History of research on cysticercosis

Cysticercosis was first studied in the late 17th century by Edward Tyson *et al.* Up to now, there have been many studies on epidemiology, pathology, diagnosis and treatment of cysticercosis in humans. These studies have made important contributions to the treatment and prevention of cysticercosis in humans.

2. Life cycle of the tapeworm *Taenia solium* and Cysticercosis

Cysts of Cysticercus cellulosae can be found anywhere in the host body. Depending on the number of cysts and the location of the cysts, there are clinical manifestations of varying severity or this disease may cause death. Parasitic cysts of Cysticercus cellulosae are often found in subcutaneous tissue, brain, eyes, skeletal muscle, heart, liver, lungs, and abdominal cavities.
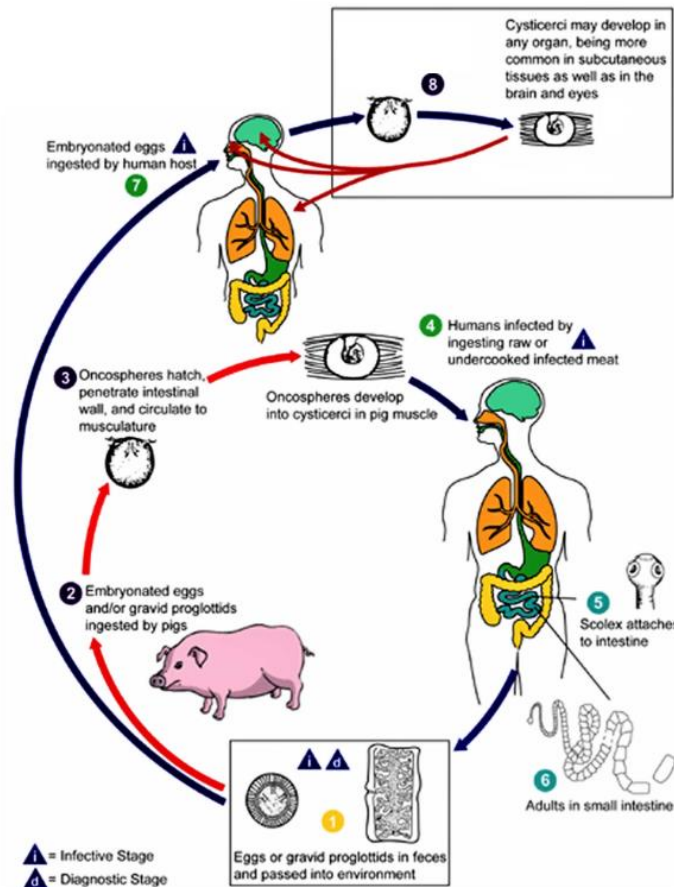
Figure 1.2. Life cycle of Taenia solium cysticercosis

3. Clinical and paraclinical characteristics of cysticercosis

3.1. Clinical characteristics of cysticercosis

Cysts of Cysticercus cellulosae in the central nervous system

Headache, epilepsy, nausea, vomiting, cerebral edema, papilloedema, double vision, decreased vision that can lead to blindness, etc.

Cysts of Cysticercus cellulosae in eyes: Patients may experience pain around eyes; glare and visual disturbances are also very diverse depending on the location of cysts of Cysticercus cellulosae, which can cause reduced vision, blindness, etc.

Cysts of Cysticercus cellulosae in the heart muscle: Heart beats fast; heart sounds change; patient has difficulty breathing and faints.

3.2. Paraclinical characteristics

3.2.1. Biopsy

It is the most specific and accurate test to diagnose cysticercosis. Biopsy of cysts in the brain and some other locations such as the spinal cord, eye socket, and myocardium is difficult to perform.

3.2.2.Diagnosis of immune serology

In recent years, ELISA (Enzyme Linked Immunosorbent Assay) has been widely used because it is easier to perform on many samples

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than EITB (Enzyme-Linked Immunoelectrotransfer Blot), and also has high sensitivity and specificity. However, the ELISA method often gives positive results for some other parasites such as strongyloides stercoralis and schistosomiasis.

3.2.3. Cerebrospinal fluid testing

When testing the cerebrospinal fluid of patients infected with cysticercosis, abnormalities were found in over 50% of cases.

3.2.4. Diagnostic imaging
- X-ray
- CT scan or MRI of the brain

These two methods are currently widely used in Vietnam. However, the cost is still quite high and difficult to implement for people with low incomes.

4. Images of cysts of Cysticercus cellulosae on brain magnetic resonance imaging film

According to BargaveeVenka *et al.* 2016 and Radiography, images of cysts of Cysticercus cellulosae are divided into stages of fluid cysts, colloid fluid cysts, granular nodular cysts and calcified cysts.

Fluid cyst stage (stage 1): The cyst has an intact membrane so there is no picture of brain edema around the cyst. On the T1W image with contrast medium injection, the enhancing cyst is round, clear, with a scolex-shaped enhancement point, decreased in density, and not enhancing contrast with a size of 5-10 mm.

Colloid fluid cyst stage: The pericystic membrane has leakage and edema surrounding the cyst. MRI images show rim-shaped enhancement (cyst shell). It is divided into 2 stages:

Stage 2: On T1W image with contrast medium injection, the cyst has a round-shaped enhancing rim, a scolex-shaped enhancing spot, decreased density, and and not enhancing contrast with a size of 5-10 mm.

Stage 3: On T1W image with contrast medium injection, a ring-shaped enhancing cyst is seen, with a clear central tissue nodule, decreased density, and no contrast enhancement.

Granular nodular cyst stage (stage 4): The cyst shrinks from 2-4 mm, the shell is thicker, the scolex is completely calcified, and edema of the brain tissue around the cyst is reduced.

Calcified cyst stage (stage 5): The cysts of Cysticercus cellulosae is completely calcified, the calcification nodules are 1-3

mm in size, there is no longer edema of the brain tissue around the cyst, the calcifications are getting smaller and disappear, CT scans show small calcifications about 2 mm in size that clearly obscure contrast.

- In addition, around the cysts, cerebral edema is seen when there is decreased signal on T1, increased signal on T2, clearly seen in the white matter, in the shape of a gloved finger.

Through the 5 stages of cysts of Cysticercus cellulosae in the brain, only stages 1, 2, 3 are the active period of cysts of Cysticercus cellulosae, the neurological clinical manifestations are more obvious. The stage 4 (regressing cystic nodule stage) and the calcified cyst stage are the inactive stages of cysts of Cysticercus cellulosae.

5. Diagnosis of neurocysticercosis

5.1. Criteria for diagnosing cysticercosis

According to the guideline for diagnosis and treatment of the National Institute of Malariology, Parasitology and Entomology in 2015 (NIMPE.HD 08 PP/06).

5.2. Criteria for diagnosing neurocysticercosis: Refer to some authors, latest diagnostic criteria by Garcia Hector, 2021

6. Treatment of neurocysticercosis

- ***Principles:*** Depending on the clinical condition and level of injury, choose the appropriate treatment regimen on the principle of combining specific treatment for cysticercosis, symptomatic treatment and supportive treatment.

- ***Surgical treatment:*** In some cases of neurocysticercosis, surgical treatment is often applied to connect the ventricles for cases of hydrocephalus. Reducing spinal cord compression is sometimes alsoachieved by surgical intervention. Biopsy of cysts is used to diagnose and determine the cause of the disease for more effective treatment.

- ***Medical treatment:*** Currently, when treating cysticercosis, most cases are treated medically with drugs that kill Cysticercus cellulosae such as praziquantel and albendazole. Thanks to these drugs, many patients infected with cysticercosis have been cured or improved significantly.

CHAPTER 2
RESEARCH OBJECTS AND METHODS
2.1. Research objects and research methods for the goal 1

2.1.1. Objects, location and time of research

- Research objects: Patients came for medical examination and were diagnosed with neurocysticercosis at Dang Van Ngu Hospital, the National Institute of Malariology, Parasitology and Entomology (2017-2020).

- Research location: Dang Van Ngu Hospital, the National Institute of Malariology, Parasitology and Entomology.

- Research period: From January 2017 to December 2020.

2.1.2. Research Methods

2.1.2.1. Research design

The research was designed using the descriptive research method of a series of cases.

2.1.2.2. Sample size and sample selection method

Research sample size: Apply the sample size calculation formula that describes a prevalence rate.

$$n = Z^2_{(1-\alpha/2)} \frac{p(1-p)}{d^2}$$

Where:

n: Research sample size

p: Proportion of patients with simple headaches. According to a study in Vietnam in 2013, the headache rate was 58%, so take p = 0.58.

Z (1- α/2): Reliability coefficient, corresponding to 95% reliability, $Z_{1-\alpha/2}$ = 1.96;

d: Desired error: 0.09

With the selected values, the calculated sample size was 115. In fact, there were 120 patients in the study.

2.1.3.4. Variables in the study

Variables include:

- Administrative variables such as epidemiological area, age, gender, occupation, ethnicity, address.

- Clinical variables.

- Paraclinical variables such as ELISA tests for detection of *Cysticercus cellulosae*, eosinophils, urea biochemical index, creatinine, GOT, GPT.

2.1.2.5. Indicators of clinical and paraclinical characteristics

- Frequency and proportion of patients with neurocysticercosis by age, gender, ethnicity and occupation.

- Frequency and proportion of clinical symptoms mainly appearing in patients with neurocysticercosis.

- Frequency and proportion of patients with tests for eosinophils, GOT, GPT, and creatinine, urea, anti-Cysticercus cellulosae antibodies.

2.1.2.6. Data collection method

- Interview, - Clinical examination, - Paraclinical examination

2.1.2.7. Techniques used in research

Using research medical records and documents from Dang Van Ngu Hospital (Department of Specialized Medical Examination), the National Institute of Malariology, Parasitology and Entomology.

ELISA technique for detection of Cysticercus cellulosae

Using the biological test kit for detection of the Cysticercus cellulosae from Scimedx, USA with 100% sensitivity and 97% specificity.

2.2. Research methods for the goal 2

Description of the image of cysts of Cysticercus cellulosae in the brain on magnetic resonance imaging, and the relationship with some clinical symptoms

2.2.1. Objects, location and time of research

- ***Research objects:*** Like the goal 1
- ***Research location***

Like the goal 1

Location for performing and reading magnetic resonance imaging (MRI) at the Imaging Diagnostic Center at No. 178, Thai Ha Street, belonging to the Agricultural General Hospital.

- ***Research time:*** Like the goal 1

2.2.2. Research Methods

Research design, sample size, inclusion and exclusion criteria, sampling method as the goal 1.

2.2.3. Steps to conduct research

For goal 1, magnetic resonance imaging was performed twice in 1 patient.

- First time: before treatment
- Second time: after 6 months (from the first day of treatment)
- Films were read by specialists and associate professors in the field of diagnostic imaging at the Imaging Diagnostic Center at No. 178, Thai Ha Street.

2.2.4. Variables and indicators in research

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2.2.4.1. Variables

Cysts of Cysticercus cellulosae on cranial MRI: On each cranial MRI, there can be many cysts of Cysticercus cellulosae with different sizes in many different stages, and lesions of cysts of Cysticercus cellulosae can be in many locations. Cyst characteristics: Divided into stages of parasitic cysts of Cysticercus cellulosae in the brain.

2.2.4.2. Indicators

- Frequency and rate of visual characteristics of cysts of Cysticercus cellulosae in the brain on MRI in researched patients: In terms of quantity, size, location and stage, pericystic cerebral edema of cysts of Cysticercus cellulosae on brain MRI.

- Relationship between the number of cysts, cyst stage and location of cyst appearance with some clinical symptoms.

2.2.5 Techniques used in research

- ***Imaging diagnostic techniques:*** Capture and analyze and evaluate the characteristics of cysts of Cysticercus cellulosae on brain MRI.

2.3. Research method of the goal 3

Evaluation of treatment results in patients with neurocysticercosis using two regimens albendazole and praziquantel.

2.3.1. Objects, location, time of research

- ***Research objects***: Patients diagnosed with neurocysticercosis and admitted to the hospital for treatment.

2.3.3. Research Methods

2.3.3.1. Research design

The thesis was designed using the treatment intervention research method using two regimens: praziquantel and albendazole.

2.3.3.2. Sample size and sampling method

120 studied patients in goal 1 were divided into two groups of 60 patients; group 1 was treated with albendazole while group 2 was treated with praziquantel. The patients were selected and divided according to the numbering principle from 1 to 120. Patients with odd numbers are treated for cysticercosis with albendazole regimen, and group 2 is treated for cysticercosis with praziquantel regimen.

2.3.3.4. Variables in the study

- Clinical indicators at follow-up examinations at post-treatment times are as goal 1.

- Hematological and biochemical indicators at follow-up examination at the time before treatment of stage 2, stage 3 and after 6

months from the date of taking the first dose of treatment are as goal 1.

- Characteristics of cysts of Cysticercus cellulosae on brain MRI after 6 months of first dose treatment (D180, when the treatment start date is D1).

- Variables on treatment results: According to the standard procedure of the National Institute of Malariology, Parasitology and Entomology NIMPR.HD 08 PP/06 [57], evaluate the results of cure, disease reduction and no cure.

2.3.3.5 Evaluation indicators

+ Frequency and rate of reduction in clinical symptoms of neurocysticercosis before treatment and after each treatment, after 6 months of treatment with albendazole and praziquantel.

+ Average values of GOT, GPT, creatinine, urea after each treatment period of each drug.

+ Percentage of patients with cyst reduction, cyst clearance, cyst size reduction, and cyst stage transition after 6 months of treatment with albendazole and praziquantel.

+ Percentage of patients cured, with symptom relief, and without symptom relief after 6 months of treatment with albendazole and praziquantel.

+ Indicators of drug safety:

2.3.3.6 Data collection method

2.3.3.7. Techniques used in research

Using research medical records and documents from Dang Van Ngu Hospital (Department of Specialized Medical Examination), the National Institute of Malariology, Parasitology and Entomology.

2.4. Data processing and analysis

CHAPTER 3
RESEARCH RESULTS

3.1. Clinical and paraclinical characteristics of neurocysticercosis

3.1.1. General information about patients with neurocysticercosis

With 120 patients participating in the study, the average age was 51.2 ± 11.6 years old; ranging from 18 - 83 years old. Patients with neurocysticercosis occurred in all different age groups, the highest being in the group from 40 - < 60 years old.

Among 120 patients participating in the study, the male/female ratio was 4:1.

The majority of patients with neurocysticercosis were Kinh people, accounting for 57.5%, followed by patients of Tay ethnicity, accounting for 16.7%, and Thai people, 9.1%. Other ethnic groups accounted for a low percentage.

Patients with neurocysticercosis were mainly farmers, 71/120 people, accounting for 59.2%, and workers, officers, housewives, etc.

3.1.2. Clinical and paraclinical characteristics of neurocysticercosis of the research group

3.1.2.1. Clinical characteristics of patients with neurocysticercosis

Table 3.3. First symptoms at the onset of the disease

First symptom	Number of patients	Rate (%)
Convulsion	68	56.7
Headache	38	31.7
Numbness in hands and feet	5	4.1
Gravid proglottids in feces	3	2.5
Faint	2	1.7
Subcutaneous cyst	2	1.7
Dizziness, loss of balance	1	0.8
Lisping, difficulty speaking	1	0.8
Total	120	100.0

Table 3.5. Clinical symptoms upon admission to hospital

Clinical symptoms upon admission to hospital	Number of patients	Rate (%)
Headache	106	88.3
Simple headache	35	29.2
Headache + Convulsions	9	7.5
Headache + Muscle tics	8	6.6
Headache + Convulsions + Muscle tics	54	45.0
Convulsion	72	60.0
Muscle tics	70	58.3
Faint	29	24.2
Memory loss	23	19.2

Numbness of hands and feet	19	15.8
Vomiting, nausea	12	10.0
Dizziness, balance disorders	11	9.2
Muscle weakness	10	8.3
Other symptoms*	12	10.0

Note: *Other symptoms: Gravid proglottids in feces, cysts under the skin, blurred vision.

3.1.2.2. Paraclinical characteristics of patients with neurocysticercosis

There were 2 cases of mild anemia; 23 cases (19.2%) increased SGOT, 27 cases (22.5%) increased SGPT but all only slightly increased no more than 3 times the normal value. There was only 1 case where SGOT increased to 166.2 U/L; and 1 case of increased SGPT to 146.5 U/L. While the patients' urea and creatinine kidney functions were within normal limits.

Eosinophil test results showed that 15% of patients had increased eosinophilia in peripheral blood, 85% of patients had no increase. The average eosinophil rate was 5.1 ±5.6 %; ranging from 0.5% to 54%.

There were 104 patients tested by ELISA to detect anti-Cysticercus cellulosae antibodies, and 22 patients were positive with an average OD of 0.97±0.54.

3.2. Characteristics of image of cysts of Cysticercus cellulosae on brain MRI

Table 3.10. Location of cysts of Cysticercus cellulosae on brain MRI (n=120)

Lesion location on MRI	Number of patients	Rate (%)
Cerebral hemisphere	83	69.2
Cortex/subcortex	61	50.8
Cerebellum	11	9.2
Ventricular	1	0.8
Subarachnoid space	3	2.5
Other locations (brainstem, corpus callosum)	2	1.7

Table 3.12. General characteristics of cysts of Cysticercus cellulosae in the brain

Indicator	Lesion location	Rate (%) compared to number of patients (n=120)
Number of cysts		
1 cyst	46	38.33
2 - 5 cysts	59	49.17
> 5 cysts	50	41.67
Uncountable	6	5
Cyst stage		
Stage 1, 2	79	65.8
Stage 3, 4	75	62.25
Stage 5	5	4.17
Cyst size		
< 5mm	41	34.17
≥ 5 – 10 mm	96	80
>10mm	24	20

Table 3.13. Number of cysts of Cysticercus cellulosae per patient

Number of cysts	Number of patients	Rate (%)
1 cyst	22	18.3
≥ 2 cysts	98	81.7
Total	120	100

Table 3.14. Characteristics of cysts of Cysticercus cellulosae in the cerebral hemisphere n=83

Indicator	Number of patients	Rate (%)
Number of cysts		
1 cyst	7	8.4
2 - 5 cysts	26	31.3
>5 cysts	45	54.2
Uncountable	5	6.1
Cyst stage		

Stage 1, 2	38	45.8
Stage 3, 4	41	49.4
Stage 5	4	4.8
Cyst size		
< 5mm	24	28.9
≥ 5 – 10 mm	51	61.5
>10mm	8	9.6

Table 3.15. Characteristics of cysts of Cysticercus cellulosae in the cortex/subcortex n=61

Indicator	Number of patients	%
Number of cysts		100.0
1 cyst	25	41.0
2 - 5 cysts	30	49.2
> 5 cysts	5	8.2
Uncountable	1	1.6
Cyst stage		
Stage 1, 2	33	54.1
Stage 3, 4	27	44.3
Stage 5	1	1.6
Cyst size		
< 5mm	12	19.7
≥ 5 – 10 mm	37	60.6
>10mm	12	19.7

Table 3.16. Characteristics of cysts of Cysticercus cellulosae in the cerebellum n=11

Indicator	Number of patients	%
Number of cysts		100.0
1 cyst	8	72.7
2 - 5 cysts	3	27.3
>5 cysts	0	0
Uncountable	0	0
Cyst stage		
Stage 1, 2	6	54.55
Stage 3	5	45.45
Stage 4, 5	0	0
Cyst size		

< 5mm	3	27.3
≥ 5 – 10 mm	6	54.5
>10mm	2	18.2

Table 3.17. Characteristics of cysts of Cysticercus cellulosae in other locations

Indicator	Subarachnoid space	Ventricular	Brainstem	Corpus callosum
***Number of cysts** (1 cyst)*	3	1	1	1
Cyst stage				
Stage 1, 2	3	1		
Stage 3			1	
Stage 4	0	0	0	1
Cyst size				
< 5mm	0	1	1	0
5 – 10 mm	1	0	0	1
>10mm	2	0	0	0

Table 3.18. Pericystic cerebral edema in patients with cysticercosis

No.	Cyst location	Number of patients	Cyst stages 1,2,3,4	Number of cysts with edema	Rate (%)
1	Cortical/subcortical cysts	61	60	32	53.3
2	Cerebral hemisphere cyst	83	71	36	50.7
3	Cerebellar cyst	11	11	2	18.2
4	Cysts in other locations	6	5	0	0

3.2.3. Relationship between cysticercosis and clinical characteristics

Table 3.19. Relationship between clinical symptoms and pericystic edema

Clinical symptoms	≤ 2 symptoms	≥ 3 symptoms

Pericystic edema	No. of Patients	No. of Patients	Rate (%)	No. of Patients	Rate (%)
Yes	65	10	15,4	55	84.6
No	55	26	47,3	29	52.7
Total	120	36	30,0	84	70.0
$\chi2$		p = 0.002			

Table 3.20. Relationship between headache symptoms and pericystic edema

Clinical symptoms		Headache		No headache	
Pericystic edema	No. of Patients	No. of Patients	Rate (%)	No. of Patients	Rate (%)
Yes	65	55	84.6	ten	15.4
No	55	51	92.7	4	7.3
Total	120	106	88.3	14	11.7
$\chi2$		p = 0.168			

Table 3.21. Relationship between convulsion symptoms and pericystic edema

Clinical symptoms		Convulsion		No convulsion	
Pericystic edema	No. of Patients	No. of Patients	Rate (%)	No. of Patients	Rate (%)
Yes	65	49	75.4	16	24.6
No	55	23	41.8	32	58.2
Total	120	72	60.0	50	40.0
$\chi2$		p = 0.002			

Table 3.22. Relationship between muscle tics symptoms and pericystic edema

Clinical symptoms		Muscle tics		No muscle tics	
Pericystic edema	No. of Patients	No. of Patients	Rate (%)	No. of Patients	Rate (%)
Yes	65	47	72.3	18	27.7
No	55	23	41.8	32	58.2
Total	120	70	58.3	50	41.7
$\chi2$		p = 0.001			

Table 3.23. Relationship between convulsion and pericystic edema in the cerebral hemisphere

Clinical symptoms		Convulsion		No convulsions	
Pericystic edema	No. of Patients	No. of Patients	Rate (%)	No. of Patients	Rate (%)
Yes	36	23	63.9	13	36.1
No	47	26	55.3	21	44.7
Total	83	49	59.0	34	41.0
χ2		p = 0.431			

Table 3.24. Relationship between convulsion and pericystic edema in the cortex/subcortex

Clinical symptoms		Convulsion		No convulsion	
Pericystic edema	No. of Patients	No. of Patients	Rate (%)	No. of Patients	Rate (%)
Yes	32	29	90.6	3	9.4
No	29	14	48.3	15	51.7
Total	61	43	70.5	18	29.5
χ2		p = 0.003			

3.3. Results of treatment of 2 regimens albendazole and praziquantel in patients with neurocysticercosis

3.3.1. General information of patients with neurocysticercosis according to treatment regimen

- Distribution of patients with neurocysticercosis into 2 treatment groups in all age groups.
- Gender distribution of patients with neurocysticercosis according to the treatment regimen equal in both males and females.

3.3.2. Clinical characteristics of patients with neurocysticercosis according to two treatment regimen groups

Table 3.27. Some clinical symptoms at hospital admission according to treatment regimen

Symptoms at hospital admission	Albendazole (n_1 =60)		Praziquantel (n_2 =60)		p
	No. of patients	%	No. of patients	%	

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Headache	56	93.3	50	83.3	= 0.088
Convulsion	41	68.3	31	51.7	= 0.062
Muscle tics	39	65.0	31	51.7	= 0.139
Numbness of hands and feet	8	13.3	11	18.3	= 0.522

3.3.3. Paraclinical characteristics of patients with neurocysticercosis according to two treatment regimen groups

- Hematological and biochemical indexes of patients with neurocysticercosis according to the treatment regimen of the two treatment groups were equivalent (p > 0.05).

3.3.4. Imaging (MRI) characteristics of patients with neurocysticercosis according to treatment regimen

- Characteristics and location of cysts of Cysticercus cellulosae on brain MRI of the 2 study groups were quite similar.

3.3.5. Treatment results of 2 regimens albendazole and praziquantel

3.3.5.1. Change of clinical symptoms after each treatment course

Clinical symptoms gradually decreased after each treatment course. The rate of headache after the third treatment was 25% in the albendazole treatment group and 21.7% in the praziquantel treatment group, but symptoms were significantly reduced compared to before treatment; patients mainly have occasional headaches, not as many headaches as before treatment. Other symptoms such as muscle tics and numbness in the limbs still existed but at a low rate.

3.3.5.2. Treatment results after 6 months
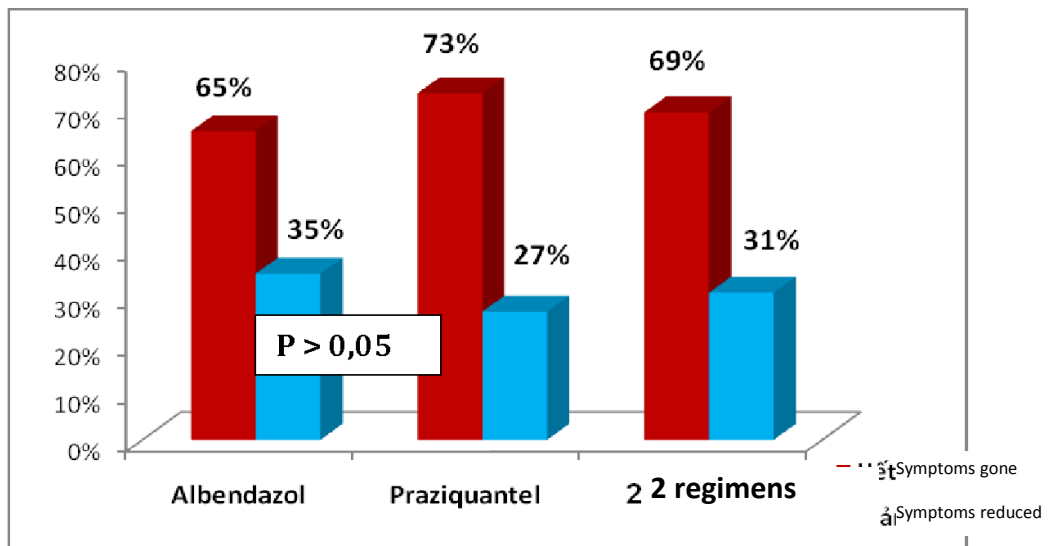
Clinical results:

Figure 3.3. Clinical results after 6 months of treatment

Results on imaging (MRI) in several locations:
Table 3.32. Treatment results on the number of cysts of Cysticercus
cellulosae in the cerebral hemisphere according to 2 regimens

Number of cysts	Albendazole		Praziquantel	
	Before treatment n (%)	After treatment n (%)	Before treatment n (%)	After treatment n (%)
No cyst		5 (10.9)		13(35.2)
1 cyst	2 (4.4)	3 (6.5)	5 (13.51)	1 (2.7)
2 - 5 cysts	10 (21.7)	17 (36.9)	16 (43.24)	15 (40.5)
> 5 cysts	30 (65.2)	20 (43.5)	15 (40.54)	8 (21.6)
Uncountable	4 (8.7)	1 (2.2)	1 (2.71)	0
Total	46 (100.0)	46 (100.0)	37 (100.0)	37 (100.0)
Fisher's exact test	p= 0.001		p = 0.001	
	p (after alb and pra treatment) = 0.444			

Table 3.33. Treatment effect on cyst size
in the cerebral hemisphere according to 2 regimens

Cyst size	Albendazole		Praziquantel	
	Before treatment n (%)	After treatment n (%)	Before treatment n (%)	After treatment n (%)
< 5mm	9 (19.6)	37 (90.2)	15 (40.5)	22 (91.7)
$\geq 5 - 10$ mm	31 (67.4)	4 (9.8)	20 (54.1)	2 (8.3)
>10mm	6 (13.0)	0	2 (5.4)	0
Total	46 (100.0)	41 (100.0)	37 (100.0)	24 (100.0)
Fisher's exact test	p = 0.001		p= 0.001	
	p (after alb and pra treatment) = 0.848			

Table 3.34. Treatment results on the number of cysts of Cysticercus
cellulosae in the Cortex/subcortex according to 2 regimens

	Albendazole	Praziquantel

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Number of cysts	Before treatment n (%)	After treatment n (%)	Before treatment n (%)	After treatment n (%)
No cyst		10 (37.1)		13 (38.2)
1 cyst	13 (48.2)	8 (29.6)	12 (35.3)	11 (32.4)
2 - 5 cysts	13 (48.2)	8 (29.6)	17 (50.0)	7 (20.6)
>5 cysts	1 (3.6)	1 (3,7)	4 (11.8)	3 (8.8)
Uncountable	0	0	1 (2.9)	0
Total	27 (100.0)	27 (100.0)	34 (100.0)	34 (100.0)
Fisher's exact test	p= 0.001		p= 0.001	
	p (after alb and pra treatment) = 0.797			

Table 3.35. Treatment results on the size of cysts of Cysticercus cellulosae in the Cortex/subcortex according to 2 regimens

Cyst size	Albendazole		Praziquantel	
	Before treatment n (%)	After treatment n (%)	Before treatment n (%)	After treatment n (%)
< 5mm	4 (14.8)	16 (94.1)	8 (23.5)	20 (95.2)
≥ 5 – 10 mm	20 (74.1)	1 (5.9)	17 (50.0)	1 (4.8)
>10mm	3 (11.1)	0	9 (26.5)	0
Total	27 (100.0)	17 (100.0)	34 (100.0)	21 (100.0)
Fisher's exact test	p= 0.001		p= 0.001	
	p (after alb and pra treatment) = 0.878			

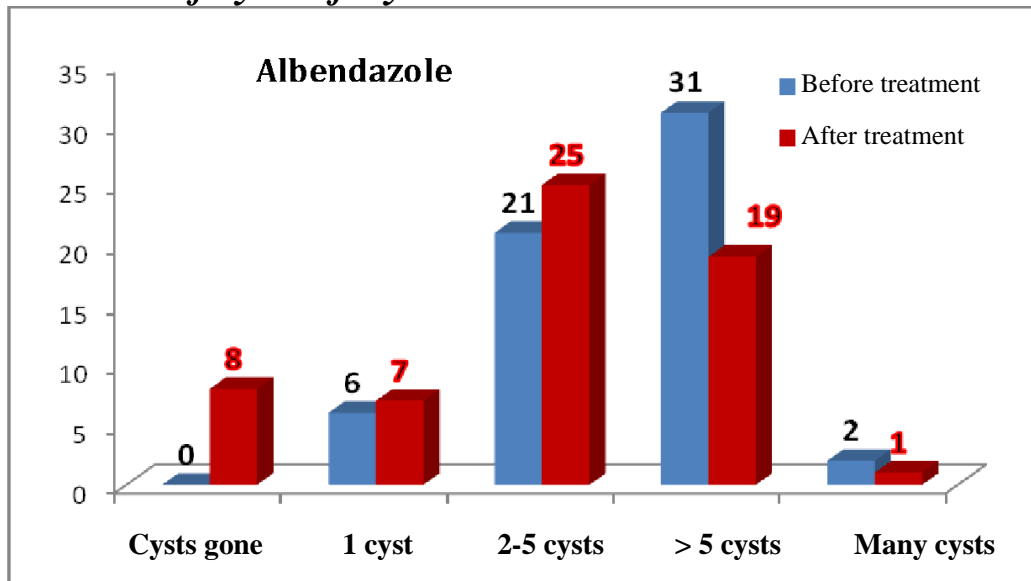**Results of cysts of Cysticercus cellulosae on brain MRI:**

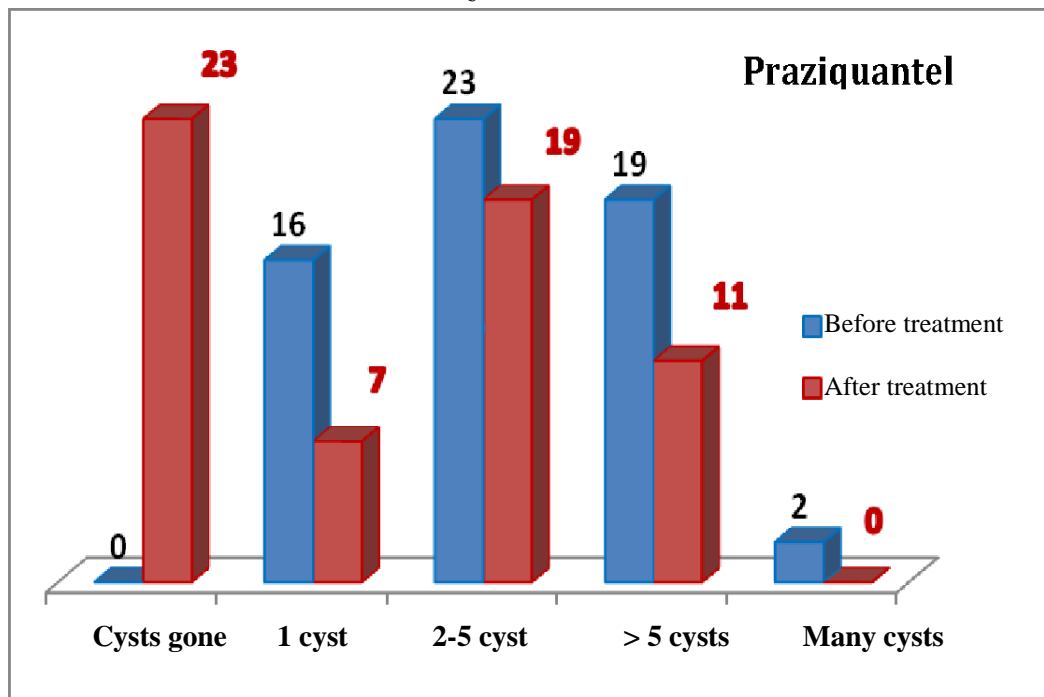*Figure 3.4. Change in the number of cysts after 6 months of albendazole treatment*

Figure 3.5. Change in the number of cysts after 6 months of praziquantel treatment
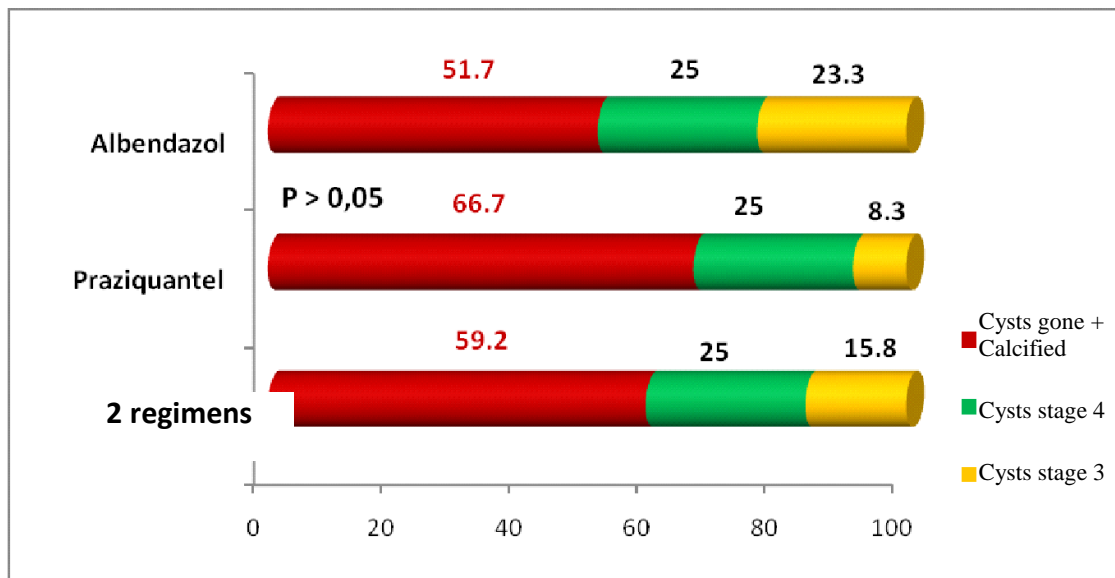
Image 3.6. Treatment results across stages of cysts of Cysticercus cellulosae of 2 regimens

Table 3.38. Treatment results on brain MRI of 2 regimens

Regimen Indicator	Albendazole		Praziquantel		2 regimens	
	No. of patients	%	No. of patients	%	No. of patients	%
Cysts gone or calcified cysts	31	51.7	40	66.7	71	59.2
Cyst reduced	29	48.3	19	31.7	48	40.0
Unchanged	0		1	1.6	1	0.8
Total	60	100	60	100	120	100
	Fisher's exact test, p = 0.093					

Treatment results

*Table 3.39. General treatment results **of the 2 study groups***

Regimen Indicator	Albendazole		Praziquantel		2 regimens	
	No. of patients	%	No. of patients	%	No. of patients	%
Cured	23	38.3	32	53.3	55	45.9
Relieved	37	61.7	27	45.0	64	53.3
Not cured	0		1	1.7	1	0.8
Total	60	100	60	100	120	100
	Fisher's exact test, p = 0.099					

3.3.6.Drug safety

Most patients did not have increased clinical manifestations. A few patients had symptoms such as fatigue when taking medicine, mild abdominal pain without intervention, and the symptoms disappeared within 24 hours.

After each treatment course, SGOT and SGPT liver enzyme activities increased compared to before treatment. However, only the albendazole treatment group witnessed the increase and had a statistically significant difference compared to before treatment with $p < 0.05$. In all cases, after a period of stopping the drug, GOT and GPT enzyme activities returned to normal without treatment intervention. Urea and creatinine indicators before and after treatment did not differ in both groups.

CHAPTER 4. DISCUSSION

The study shows that the reasons patients came to the hospital include neurological symptoms. Most patients had symptoms of headache with 88.3%; convulsions 60%, muscle tics 58.3%, 24.2% faint; The number of patients showing signs of memory loss was 23/120, accounting for 19.2%. 15.8% had symptoms of numbness in the limbs. In addition, there were other symptoms such as: vomiting, nausea, balance disorders, muscle weakness. 5% of patients had gravid proglottids in feces. The number of patients with subcutaneous cysts was 2.5%. Three patients had symptoms of blurred vision, accounting for 2.5%.

Similar to some domestic and foreign studies on clinical symptoms, patients with neurocysticercosis with a confirmed diagnosis often have typical neurological symptoms, the most common of which is headache. In the present study, prolonged headache symptoms account for 88.3% (106/120 patients). The frequency and intensity of headaches also vary depending on the parasitic location of the cysts of Cysticercus cellulosae, the inflammation and cerebral edema around the cyst. Followed is convulsion, with up to 72/120 patients having convulsions, accounting for 60%. Many patients had symptoms of muscle tics and muscle tics, with 58.3% (70/120 patients).

The number of neurocysticercosis patients with faint was 29/120, accounting for 24.2%, and patients with numbness in the limbs accounting for 15.8%.

There were 12 patients with symptoms of vomiting, nausea, accounting for 10%.

The number of patients with symptoms of shock, balance disorders and muscle weakness were 9.2% and 8.3%, respectively.

There were 6 patients with gravid proglottids in feces (5%) while the proportion of patients with subcutaneous cysts of Cysticercus cellulosae was only 2.5% and the lowest symptom is blurred vision, 2.5%.

All patients with neurocysticercosis infection in this study were assigned to undergo complete biochemical and hematological testing.

Of the 120 patients participating in the study who had blood tests, only 1.7% (2/120) showed signs of anemia when the Hb index was < 120 g/dl.

Regarding liver function before treatment: Out of 120 studied patients, there were 23 cases (19.2%) with increased GOT, 27 cases (22.5%) with increased GPT but all only slightly increased < 3 times the normal value.

Regarding the eosinophil indicator, through patient statistics, it was found that almost all patients with neurocysticercosis infection did not have an increase in eosinophils, there were 18 (15%) cases with an increase in eosinophils ≥ 7%.

Regarding ELISA for detection of anti-Cysticercus cellulosae, 104 out of 120 patients were tested by ELISA to detect anti-Cysticercus cellulosae antibodies, and 16 patients were not tested by ELISA. Among them, 22/104 patients were positive with an average OD of 0.97±0.54; the rate of patients with positive results was low, accounting for 18.4%; and 82/104 patients were tested for antibodies in their serum using ELISA technique with negative results, accounting for 68.3%. It is assumed that most patients with active larval cysts are serologically positive for both antibodies and antigens.

CONCLUSION

1. Clinical and paraclinical characteristics in a group of patients with neurocysticercosis

- With 120 patients participating in the study, the main clinical symptoms were: headache 88.3 %, convulsions 60 %, muscle tics 58.3%, faint 24.2%. Other symptoms had a low rate.

- The main clinical symptoms appeared equally in all age groups and genders.

- The rate of patients with anemia was 1.7%, 19.2% with increased GOT, 22.5% with increased GPT.

- The rate of patients with increased eosinophilia is 15%.

- The rate of patients positive for Cysticercus cellulosae antibodies was 18.4%.

2. Imaging characteristics of cysts of Cysticercus cellulosae on MRI film.

- In each patient infected with neurocysticercosis, there can be many cysts, many sizes, many different stages, and in many different anatomical locations in the brain.

- The rate of patients with cysts of Cysticercus cellulosae in the cerebral hemisphere was 69.2%, in the cortex/subcortex area 50.8%, in the cerebellum 9.2%, in the subarachnoid space 2.5%.

- The number of cysts of Cysticercus cellulosae per patient was mainly in 1 anatomical location on the brain, accounting for 69.2%, in 2 locations, accounting for 27.5%, and in 3 locations, accounting for 3.3%.

- Patients with cysticercosis infection often had multiple cysts, and the rate of patients with more than 2 cysts accounted for 81.7%, and the number of patients with 1 cyst in the brain was 18.3%.

- The stage of cysts of Cysticercus cellulosae in the brain was usually active cysts (stages 1,2,3), accounting for 95.8%.

- The number of cysts of Cysticercus cellulosae with pericystic edema in the cortex/subcortex accounted for the highest proportion, 53.3%. The phenomenon of pericystic edema of cysts of Cysticercus cellulosaeic in the cortex/subcortex was significantly related to clinical symptoms of convulsions and muscle tics, with $p < 0.001$.

3. Treatment results of two groups of patients treated with albendazole and praziquantel

- Clinical treatment results:

+ After 6 months of treatment, the main clinical symptoms such as headaches, convulsions, muscle tics, etc., were significantly reduced. Only 25% in the albendazole treatment group and 21.7% in the praziquantel treatment group still had headache; However, the severity of headaches decreased significantly. No more patients had convulsions, and the number of patients with muscle tics accounted for 5.0% in the albendazole group and 3.3% in the praziquantel group.

+ The rate of patients with no clinical symptoms of albendazole regimen was 65% and praziquantel regimen was 73.3%. The rate of

patients with reduced clinical symptoms in albendazole regimen was 35% and that of praziquantel was 26.7%. Treatment effectiveness of albendazole dose of 20mg/kg/24 hours x 20 days x 3 courses and praziquantel dose of 30mg/kg/24 hours x 15 days x 3 courses, each course 1 month apart on patients with neurocysticercosis, was similar.

*- **Treatment results on cysts of Cysticercus cellulosaeic determined by MRI***

+ Patients with a small number of cysts of Cysticercus cellulosaeic in the brain had a high cyst clearance rate of 66.6% with albendazole and 75% with praziquantel, and patients with many cysts had lower effectiveness.

+ All cysts in stages 1 and 2 responded well to treatment drugs. After treatment, there were no cysts left in stages 1 and 2 or cysts that had progressed to stages 3, 4, 5 with both albendazole and praziquantel.

+ The rate of patients with cysts removed after treatment with albendazole regimen was 51.7%, and praziquantel 66.7%. The rate of patients with cyst reduction after treatment with albendazole was 48.3% and praziquantel 31.7%.

- General treatment results

After 6 months of treatment, clinical and MRI cure results with albendazole regimen were 38.3%, disease reduction was 61.7%. With praziquantel regimen, the cure rate was 53.3%, disease reduction was 45%. The general treatment results of albendazole and praziquantel were the same.

Drug safety

+ Symptoms of side effects after treatment were mild and spontaneously disappeared after the patients stopped taking the drug or underwent a symptomatic treatment.

+ GOT and GPT tests before and after treatment with praziquantel did not detect any changes. Meanwhile, patients treated with albendazole had mild and moderate increases in liver enzyme activity of GOT and GPT, which returned to normal after 1 month of stopping taking the drug. Urea and creatinine did not change before and after albendazole and praziquantel treatments.

RECOMMENDATIONS

- Brain MRI is a good and effective technique for diagnosing neurocysticercosis on the brain, so this should be used as the main criterion in diagnosing neurocysticercosis.

- In this study, ELISA tests for detection of anti-Cysticercus cellulosa antibodies had low sensitivity and specificity, so this technique should be used as an additional criterion for diagnosing cysticercosis.

- Both the treatment regimen using praziquantel 30mg/kg/24 hours administered 2 times x 15 days x 3 courses and the regimen using albendazole 20mg/kg/24 hours x 20 days x 3 courses had good effects and were safe, so these two regimens are still applied in treatment today.