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Effectiveness of albendazole treatment for toxocariasis in children: A cross-sectional study in Ho Chi Minh City, Vietnam

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ABSTRACT

Objective: To evaluate the clinical efficacy of albendazole in pediatric toxocariasis.

Methods: This interventional study was conducted over a 6-month period, enrolling 117 children aged 3-15 years between 2023 and 2024 in Ho Chi Minh City, Vietnam. All patients received oral albendazole at a dosage of 15 mg/kg/day, divided into two daily doses, for five consecutive days. Treatment efficacy was assessed at 6 months based on the following criteria: (1) resolution or marked improvement of clinical symptoms; (2) negative ELISA serology; (3) normalization or significant reduction of eosinophil (EOS) counts to within the normal range; and (4) normalization or significant reduction of total IgE levels.

Results: After six months, significant reductions were observed in white blood cell (WBC) count, neutrophil (NEU) count, mean corpuscular hemoglobin (MCH), mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC), platelet (PLT) count, EOS count, ELISA optical density (OD), aspartate aminotransferase (AST), alanine aminotransferase (ALT), and creatinine levels (all $P<0.05$). Age-stratified analysis revealed that children aged 3-11 years showed statistically significant improvements in OD levels and EOS counts compared to baseline ($P<0.05$). The overall treatment recovery rate was 28%.

Conclusions: The cure rate for pediatric toxocariasis following a five-day albendazole regimen remains modest. Further research is required to optimize treatment durations and regimens to improve clinical outcomes in children.

KEYWORDS: *Toxocara* infection; Toxocariasis; Albendazole; Treatment effectiveness; Eosinophil count; Pediatric

1. Introduction

Toxocariasis is recognized as a global public health concern, particularly in low- and middle-income countries, including Vietnam[1,2]. If untreated, *Toxocara (T.) canis* larvae may persist in human tissues for years and potentially migrate to vital organs such as the eyes, brain, liver, heart, and lungs, posing a significant health risk, especially in children[3-6].

Albendazole is considered the first-line treatment for toxocariasis[7]. However, the optimal treatment duration remains controversial. Hombu *et al*. reported a recovery rate of 78% with prolonged

Summary

Question: What is the effectiveness of a 5-day albendazole regimen in children with toxocariasis in Ho Chi Minh City, Vietnam?

Findings: In this interventional study including 117 children with toxocariasis, a 5-day albendazole regimen resulted in significant improvements in clinical symptoms, eosinophil counts, and ELISA optical density values after 6 months of follow-up. The overall clinical recovery rate was 28%.

Meaning: A 5-day albendazole regimen may improve clinical and laboratory outcomes in pediatric toxocariasis, although the overall cure rate remains modest and further studies are needed to optimize treatment strategies.

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albendazole therapy lasting 4-8 weeks. In the absence of randomized clinical trials, most guidelines recommend treatment durations of 14-21 days, although several earlier studies have demonstrated favorable outcomes with shorter 5-day regimens[8].

Most European and American guidelines recommend oral albendazole at a dose of 400 mg twice daily for 5 days in both adults and children[1]. With this treatment plan, Fernando reported a recovery rate of 32%[9]. In addition, Magnaval *et al.* summarized previous studies reporting recovery rates ranging from 31.6% to 100% following 5-day albendazole regimens in patients with toxocariasis[10].

Globally and in Vietnam, data on the effectiveness of toxocariasis treatment remain limited, particularly in pediatric populations. Therefore, this study aimed to evaluate the effectiveness of albendazole treatment in children with toxocariasis in Ho Chi Minh City, Vietnam.

2. Methods

2.1. Study design and setting

This interventional study was conducted over a 6-month period, enrolling 117 children aged 3-15 years between 2023 and 2024 in Ho Chi Minh City, Vietnam. All participants underwent standardized clinical evaluation and laboratory investigations, including complete blood count (CBC), blood urea, creatinine, aspartate aminotransferase (AST), alanine aminotransferase (ALT), total IgE, and anti-*T. canis* antibody titers. Serological testing was performed using the AccuDiag™ *Toxocara* IgG ELISA kit (Cortez Diagnostics Inc., USA), approved by the Vietnamese Ministry of Health. An optical density (OD) value >0.3 was considered positive. The reported sensitivity and specificity of the assay were 87.5% and 93.3%, respectively.

2.2. Participants and diagnostic criteria

Only patients diagnosed with toxocariasis were included in the intervention. Diagnosis was established based on a positive anti-*T. canis* IgG serological result in combination with at least one clinical symptom suggestive of helminthic infection, such as pruritus, urticaria, or abdominal pain.

2.3. Treatment and follow-up

All patients received oral albendazole at a dose of 15 mg/kg/day, divided into two doses daily, for five consecutive days. Patients were followed up clinically at 1 month after treatment completion. A comprehensive reassessment, including clinical evaluation and repeat ELISA serology, was performed at 6 months post-treatment.

2.4. Outcome measures

Treatment efficacy was assessed at 6 months based on the following criteria: (1) resolution or marked improvement of clinical symptoms; (2) negative ELISA serology; (3) normalization or significant reduction of eosinophil (EOS) counts to within the normal range; and (4) normalization or significant reduction of total IgE levels.

2.5. Ethical considerations

This study was approved by the Institutional Review Board of Pham Ngoc Thach University of Medicine (Approval No. 500/HĐĐĐ-TĐHYKPNT, dated March 3, 2021) and by the Ethics Committee of Children's Hospital 2 (Approval No. 900/GCN-BVND2, dated November 11, 2022).

2.6. Data management and statistical analysis

Data were analyzed using R software version 4.3.2. Continuous variables were presented as mean ± standard deviation or median (interquartile range), while categorical variables were expressed as frequencies and percentages. Comparisons before and after treatment were performed using Wilcoxon signed-rank tests as appropriate. Categorical variables were compared using McNemar's *Chi*-square test. A P value <0.05 was considered statistically significant.

3. Results

A total of 117 children received albendazole treatment. Follow-up compliance was 100% (117/117) at 1 month and 91.5% (107/117) at 6 months (Figure 1).

Most clinical symptoms showed marked improvement after treatment. The prevalence of pruritus, urticaria, and abdominal pain decreased significantly at both 1 and 6 months post-treatment. At 6 months, these symptoms persisted in only 6.5%, 5.6%, and 3.7% of patients, respectively (Table 1).

There were statistically significant changes in white blood cell (WBC), mean corpuscular hemoglobin (MCH), mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC), platelet count (PLT), white blood cell subtypes, EOS, OD, AST, ALT, and creatinine levels at 6 months compared with baseline (all P<0.05).

Clinical characteristics of children with positive serology for *T. canis* at baseline and at 1 and 6 months after treatment were shown in Table 1. No cases of liver or renal dysfunction were observed during follow-up (Table 2).

Age-stratified analysis showed a statistically significant reduction in both OD values and EOS counts in children aged 3-11 years between baseline and 6 months after treatment (P<0.05). In contrast,

no significant changes in these parameters were observed in the 12 to 15-year age group (Figure 2).

Based on predefined criteria, the overall cure rate was 28%, whereas 72% of patients did not meet full cure criteria at 6 months.

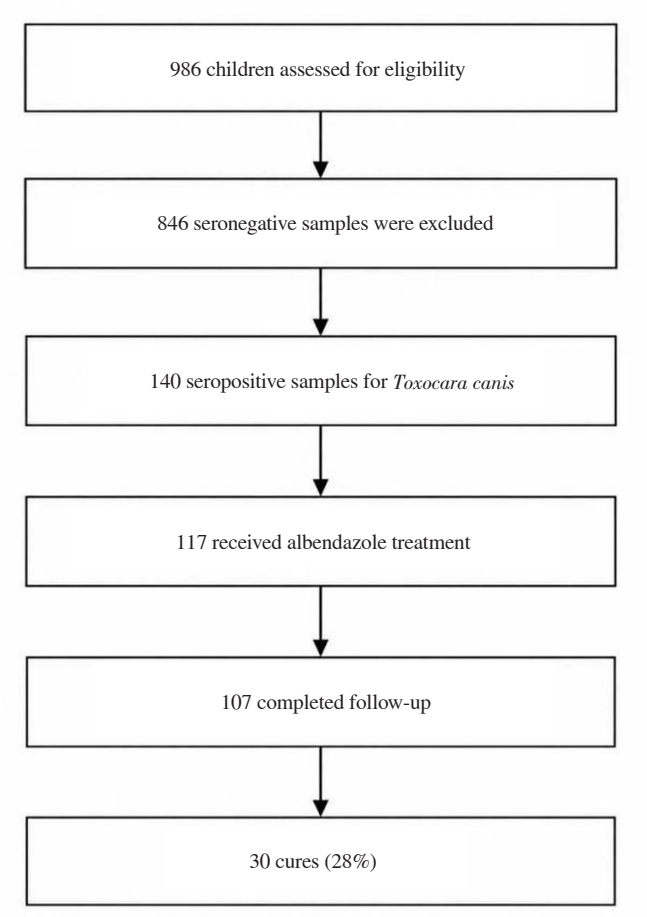

Figure 1. Flow diagram of participant enrollment, treatment, and follow-up.

Table 1. Clinical characteristics of children with positive serology for *Toxocara canis* at baseline and at 1 and 6 months after treatment [*n* (%)].

Clinical characteristics	Pre-treatment (*n*=117)	After 1 month of treatment (*n*=117)	After 6 months of treatment (*n*=107)
Pruritus	28 (23.9)	21 (17.9)	7 (6.5)
Abdominal pain	27 (23.1)	18 (15.4)	6 (5.6)
Urticaria	18 (15.4)	11 (9.4)	4 (3.7)
Anorexia	12 (10.3)	4 (3.4)	0 (0.0)
Erythema	8 (6.8)	3 (2.6)	0 (0.0)
Headache	6 (5.1)	3 (2.6)	1 (0.9)
Sleep disorders	6 (5.1)	2 (1.7)	0 (0.0)
Muscle, joint pain	5 (4.3)	2 (1.7)	0 (0.0)
Fever	4 (3.4)	1 (0.9)	0 (0.0)
Nausea, vomiting	3 (2.6)	1 (0.9)	0 (0.0)
Wheezing	2 (1.7)	1 (0.9)	0 (0.0)
Blurred vision	2 (1.7)	1 (0.9)	0 (0.0)
Dyspnea	2 (1.7)	1 (0.9)	0 (0.0)
Large lymph node	0 (0.0)	0 (0.0)	0 (0.0)
Hyperactive	0 (0.0)	0 (0.0)	0 (0.0)
Muscle weakness	0 (0.0)	0 (0.0)	0 (0.0)
Large liver	0 (0.0)	0 (0.0)	0 (0.0)
Convulsion	0 (0.0)	0 (0.0)	0 (0.0)
Others	0 (0.0)	0 (0.0)	0 (0.0)

4. Discussion

Children are particularly vulnerable to toxocariasis due to frequent contact with contaminated soil, close interaction with animals, outdoor play, and habitual hand-to-mouth behaviors, including accidental ingestion of contaminated food or soil. Although most infected individuals remain asymptomatic, the severity of tissue damage and clinical manifestations depends on the intensity and location of larval migration. The liver, lungs, and central nervous system, including the eyes, are the most commonly affected organs in human toxocariasis[5,6]. A study by Thieu Ha Van *et al*. involving 986 children aged 3-15 years in Ho Chi Minh City reported a *T. canis* seroprevalence of 14.2%[2].

Treatment of symptomatic toxocariasis is recommended to alleviate symptoms and reduce the risk of larval migration to critical organs such as the brain and eyes. In the present study, symptomatic children received albendazole at a dose of 10-15 mg/kg/day for five consecutive days, which was associated with marked clinical improvement. The prevalence of pruritus, abdominal pain, and urticaria decreased substantially, persisting in only 6.5%, 5.6%, and 3.7% of patients, respectively, at 6 months.

These findings are consistent with those reported by Gheorghe *et al*, who studied 94 children aged 4-18 years with toxocariasis and no co-infection with other intestinal parasites. Patients underwent clinical examination, complete blood count, liver enzyme assessment (ALT, AST), total IgE measurement, and *Toxocara* serology. The mean age was (11.4 ± 0.47) years. Treatment with benzimidazole derivatives (10 mg/kg/day, twice daily for 10-14 days) resulted in clinical improvement in 48.2% of treated patients compared with 23.7% in untreated patients (P<0.05)[11].

Similarly, in Vietnam, Duong *et al*. treated 126 children with albendazole (10-15 mg/kg/day for 21 days) and reported progressive clinical improvement, particularly in pruritus, urticaria, and abdominal pain, at 1 month and more markedly at 6 months[12].

In addition to clinical outcomes, our study demonstrated significant post-treatment improvements in multiple hematological and biochemical parameters, including total white blood cell count, red blood cell indices (MCH, MCV, MCHC), platelet count, EOS count, optical density, AST, ALT, and creatinine levels at 6 months (all P<0.05). Hemoglobin levels increased slightly (13.20 g/dL to 13.30 g/dL), although this difference was not statistically significant (P>0.05). Notably, significant changes were observed in red blood cell indices. These findings are consistent with Gheorghe *et al*, who reported significant post-treatment changes in hematological parameters, including a reduction in white blood cell count and changes in red blood cell parameters following treatment (P<0.05 and P<0.001, respectively). EOS percentages were significantly higher in infected patients compared with controls and decreased after treatment[11].

Kim *et al.* (2010-2013) also reported eosinophilia in children with positive *Toxocara* ELISA results following albendazole therapy, with

Table 2. Hematological, biochemical, and serological parameters before and after treatment.

Characteristics	Pre-treatment (ratio[a]) (*n*=107)	After 6 months of treatment (ratio[a]) (*n*=107)	*P*	95% *CI*[c]
WBC, K/μL[b]	8.79 (7.47, 10.49)	8.05 (6.94, 9.04)	< 0.001[d]	0.56, 1.50
NEU, K/μL[b]	4.28 (3.42, 5.48)	3.99 (3.17, 4.91)	0.016[d]	0.10, 0.95
Hb, g/dL[b]	13.20 (12.55,14.00)	13.30 (12.55, 14.05)	0.200[d]	-0.24, 0.06
MCH, pg[b]	27.8 (26.3, 28.8)	27.7 (25.9, 28.4)	< 0.001[d]	0.14, 0.45
MCV, fL[b]	85 (81, 88)	86 (82, 89)	< 0.001[d]	-1.7, -0.79
MCHC[b]	32.60 (32.00, 33.05)	31.80 (31.10, 32.40)	< 0.001[d]	0.65, 1.00
PLT, K/μL[b]	326 (275, 374)	315 (251, 353)	< 0.001[d]	14, 35
White blood cell subtypes				
Normal	55 (51.4)	80 (74.8)	< 0.001[e]	
Increased	52 (48.6)	27 (25.2)		
IgE-titers, kIU/L[b]	186 (51, 709)	216 (56, 572)	0.800[d]	-80, 109
IgE concentration classification				
Normal	62 (57.9)	62 (57.9)	> 0.900[e]	
Increased	45 (42.1)	45 (42.1)		
Eosinophil count, K/μL[b]	0.28 (0.15, 0.48)	0.24 (0.15, 0.41)	0.014[d]	0.02, 0.14
Eosinophil count classification				
Normal	65 (60.7)	76 (71.0)	0.043[e]	
Mildly increased	40 (37.4)	31 (29.0)		
Highly increased	2 (1.9)	0 (0.0)		
Combination of eosinophil count and IgE concentration classification				
Normal	45 (42.0)	53 (49.5)	0.093[e]	
Only the IgE concentration increased	20 (18.7)	23 (21.5)		
Only the eosinophil count increased	17 (15.9)	9 (8.4)		
Both the IgE concentration and the eosinophil count increased	25 (23.4)	22 (20.6)		
OD[b]	0.62 (0.46, 1.10)	0.51 (0.27, 0.88)	< 0.001[d]	0.07, 0.25
OD classification				
OD < 0.3	0 (0.0)	30 (28.0)	< 0.001[e]	
0.3 ≤ OD < 0.5	37 (34.6)	22 (20.6)		
0.5 ≤ OD < 1.0	40 (37.4)	36 (33.6)		
1.0 ≤ OD < 1.5	16 (15.0)	9 (8.4)		
OD ≥ 1.5	14 (13.1)	10 (9.3)		
AST, U/L[b]	24 (21, 29)	27 (23, 31)	< 0.001[d]	-4.0, -1.5
ALT, U/L[b]	14 (11, 17)	11 (9, 18)	0.002[d]	0.5, 3.0
Creatinine[b]	59 (54, 66)	52 (47, 59)	< 0.001[d]	5.8, 8.1
Urea[b]	3.90 (3.15, 4.70)	4.00 (3.35, 4.80)	0.200[d]	-0.34, 0.06

[a]Proportions are presented in columns unless otherwise indicated; [b]Interquartile range; 95% *CI*[c]: confidence interval calculated by Profile Likelihood method; [d]Wilcoxon signed rank with continuity correction; [e]McNemar's *Chi*-squared test. WBC: white blood cell; NEU: neutrophil count; EOS: eosinophils; Hb: hemoglobin; MCH: mean corpuscular hemoglobin; MCV: mean corpuscular volume; MCHC: mean corpuscular hemoglobin concentration; PLT: platelet count; AST: aspartate aminotransferase; ALT: alanine aminotransferase; IgE: immunoglobulin E; OD: optical density.

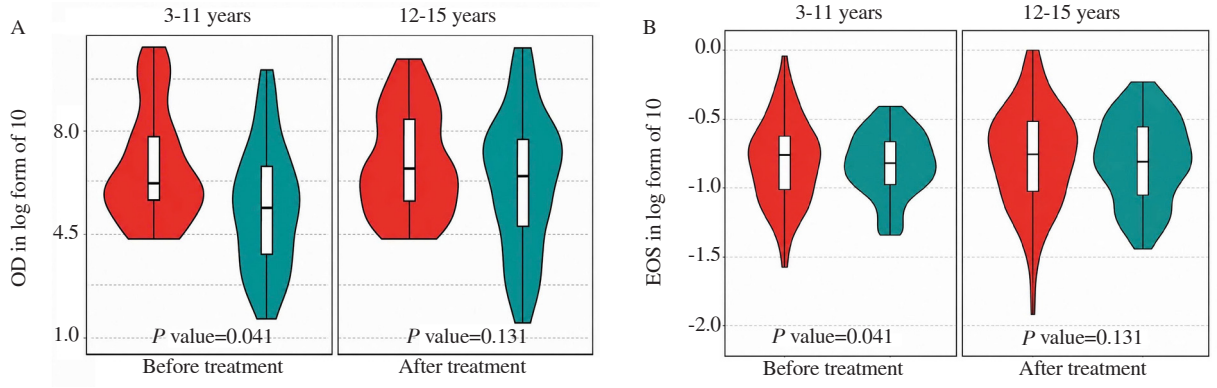

Figure 2. Age-stratified comparison of serological and hematological parameters before and after treatment. OD: optical density; EOS: eosinophils.
(A) Box-and-violin plots illustrating the distribution of OD values at baseline and 6 months post-treatment, stratified by age group (3-11 years and 12-15 years). Due to right-skewed distributions, OD values were $\log_{10}$-transformed for visualization and comparison. On the y-axis, a one-unit increase corresponds to a tenfold increase in the original OD value. (B) Box-and-violin plots illustrating EOS at baseline and 6 months post-treatment, stratified by age group. Due to right-skewed distributions, eosinophil counts were $\log_{10}$-transformed. On the y-axis, a one-unit increase corresponds to a tenfold increase in the original eosinophil count. Red represents baseline (before treatment), whereas green represents 6 months after treatment.

follow-up durations ranging from 1 week to 12 months. However, there is currently no consensus on the optimal follow-up interval for evaluating treatment response. Most authors recommend a 5-day course of albendazole at a total dose of 800 mg/day as a standard regimen[13].

In our study, a significant reduction in EOS counts was observed at 6 months after treatment ($P<0.05$).

In parasitic infections, including *T. canis*, eosinophilia is typically transient and occurs mainly during larval migration or tissue invasion. A study from Poland reported that eosinophilia was more prevalent in younger children[14]. Consistent with this, we observed significant reductions in both EOS counts and OD values in children aged 3-11 years, whereas no significant changes were found in older children. Kroten *et al*. similarly reported age-related differences in EOS response before and after treatment ($P<0.05$)[15].

Overall, our findings are consistent with the existing literature, demonstrating that treatment of *T. canis* infection leads to meaningful improvement in both clinical and laboratory parameters. In our cohort, a 5-day course of albendazole achieved a clinical cure rate of 28%.

In conclusion, a 5-day course of albendazole achieved a clinical cure rate of 28% in children with toxocariasis. Although modest, this finding highlights the need for further studies to determine the optimal treatment duration and appropriate post-treatment monitoring strategies, particularly in pediatric populations, to better evaluate therapeutic efficacy.

Conflict of interest statement

There are no conflicts of interest to declare.

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Authors' contributions

Ha Van Thieu and Ha Huy Khoi contributed equally to this article as co-first authors. Ha Van Thieu and Ha Huy Khoi made substantial contributions to acquisition, analysis, and data interpretation. Each author participated in drafting the article and revising it critically for important intellectual content. Each author gave the final approval of the version to be published and agreed to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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