Original Article

An Epidemiological Study and Seasonal Variation in Eosinophilic Meningitis

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Eosinophilic meningitis is endemic in Thailand. There is limited data on its epidemiological data and seasonal variation. This study reviewed a 2017 annual report of the National Disease Surveillance, Bureau of Epidemiology, Department of Disease Control, Ministry of Public Health, Thailand. The annual report comprised of numbers of patients, morbidity rate, mortality rate, age group, nationality, and occupations of patients diagnosed with eosinophilic meningitis by months, a public health zone, and provinces. There are currently 13 public health zones throughout Thailand and 76 provinces plus one capital city; Bangkok. There were 189 patients diagnosed with eosinophilic meningitis throughout Thailand in 2017. All patients were Thai. The common age groups were between 25 and 54 years (129 patients; 68.25%). The majority of patients were male (115 patients; 60.85%), agriculturists (88 patients; 46.56%) and lived in the northeastern part of Thailand (182 patients; 96.30%). The mortality rate was zero. Loei province had the highest number of patients and morbidity rate of Thailand at 63.49% and 18.85/100,000 population. The most common season for eosinophilic meningitis in Thailand was a rainy season (90 patients; 47.62%). Only differences by provinces were significantly related to numbers of eosinophilic meningitis by seasons (p-value = 0.004). In conclusion, the northeastern part of Thailand particularly Loei province is still endemic for eosinophilic meningitis. The infection is more prominent in working-aged male in the rainy season.

Keywords: Angiostrongylus cantonensis, Morbidity, Mortality

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Eosinophilic meningitis, caused by *Angiostrongylus cantonensis*, is defined by the presence of Eosinophils in cerebrospinal fluid of more than 10% of the total white blood cells[1]. The common symptom of eosinophilic meningitis is an acute severe headache in at least 95% of cases[2]. If left untreated, the headache may last up to 56 days[3]. Humans are an accidental host and get infected mainly by eating uncooked or partially cooked raw freshwater snails[4].

Thailand is the endemic country for human angiostrongyliasis[2]. There were at least 2,827 cases reported in literature from 1945 to 2008. Of those, 1,337 patients (47.33%) were from Thailand. However, the epidemiological data of eosinophilic meningitis in Thailand are limited. Additionally, freshwater snails are the main vectors of eosinophilic meningitis in Thailand[4]. Therefore, the correlation of numbers of patients with eosinophilic meningitis and seasonal variation should be studied.

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Materials and Methods

The present study reviewed a 2017 annual report of the National Disease Surveillance, Bureau of Epidemiology, Department of Disease Control, Ministry of Public Health of Thailand (http://www.boe.moph.go.th/boedb/surdata/disease.php?dcontent=situation&ds=55). The website received a report under the National Disease Surveillance form 506 from provincial public health offices, government hospitals, and public health centers throughout Thailand. Eosinophilic

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meningitis is one of the 52 communicable diseases reported by this system.

The annual report comprised of numbers of patients, morbidity rate, mortality rate, age group, nationality, and occupations of patients diagnosed with eosinophilic meningitis by months, a public health zone, and provinces. There are currently 13 public health zones throughout Thailand and 76 provinces plus one capital city; Bangkok. The associations of numbers of patients and seasons in Thailand were also studied. The seasons of Thailand were defined by the Thai Meteorological Department as summer, rainy, and winter. The summer season was from March to May, while rainy and winter were from June to October and November to February, respectively. These definitions were slightly modified to match with the data of the National Disease Surveillance, Bureau of Epidemiology.

Characteristics of patients with eosinophilic meningitis were presented by frequency and percentage. The morbidity rates of each public health zone and province were reported over 100,000 population. Factors associated with seasonal distribution were executed by using Chi-squared (for sex) or Fisher's exact test (for age group, provinces). Statistical analyses were performed by using STATA software, version 10.0 (College Station, Texas, USA). Figure showed distribution of eosinophilic meningitis by each public health zone was created by using an R statistical program.

Results

There were 189 patients diagnosed with eosinophilic meningitis throughout Thailand in 2017. All patients were Thai. The common age groups were between 25 and 54 years (129 patients; 68.25%). The majority of patients were male (115 patients; 60.85%), agriculturists (88 patients; 46.56%) and lived in the northeastern part of Thailand (182 patients; 96.30%) as shown in Table 1. The mortality rate was zero.

There were four public health zones with no reported case of eosinophilic meningitis (Zone 3 central 2, Zone 5 West, Zone 6 East, and Zone 12 South 2) as shown in Table 2. According to the public health zone, zone 8 had the highest numbers of patients and morbidity rate (151 patients; 79.89% and 2.74/100,000 population). Among 77 provinces, only 18 provinces had reported cases of eosinophilic meningitis (Table 2). Loei province had the highest number and morbidity rate of Thailand at 63.49% and 18.85/100,000 population as shown in Table 2 and Figure 1.

The most common season for eosinophilic meningitis in Thailand was a rainy season (90 patients; 47.62%), followed by winter (68 patients; 35.98%) and summer seasons (31 patients; 16.40%). This pattern was found in the age group over 25 years, both sexes, and in some provinces such as Loei (Table 3). Only differences by provinces were significantly related to numbers of eosinophilic meningitis by seasons (p-value = 0.004).

Table 1. Characteristics of patients with eosinophilic meningitis in Thailand between January and December 2017

Features	Numbers (%) n = 189
Age group, years	
7 to 9	3 (1.59)
10 to 14	2 (1.06)
15 to 24	30 (15.87)
25 to 34	36 (19.05)
35 to 44	48 (25.40)
45 to 54	45 (23.81)
55 to 64	14 (7.40)
≥65	11 (5.82)
Male sex	115 (60.85)
Occupation	
Agriculturists	88 (46.56)
Employees	51 (26.98)
Students	18 (9.52)
Soldier/policeman	3 (1.59)
Housekeeper	1 (0.53)
Government officer	1 (0.53)
Monks	2 (1.06)
Unknown	25 (13.23)
Regions	
Northeast (zone 7 to 10)	182 (96.30)
Central (zone 3, 4, 13)	4 (2.11)
North (zone 1, 2)	2 (1.06)
South (zone 11, 12)	1 (0.53)
West (zone 5)	0
East (zone 6)	0

Discussion

These epidemiological data of eosinophilic meningitis showed that eosinophilic meningitis was prominently found in working-age group (25 to 54 years), male (60.85%), and agriculturists (46.56%). Almost all of the cases were reported from northeastern Thailand (96.30%) with zero rates of mortality. These results indicated that the northeastern part of Thailand was an endemic area of eosinophilic meningitis as

Table 2. Morbidity rate/100,000 population of eosinophilic meningitis in Thailand (2017) by public health zone and provinces

Zones/provinces	Numbers (%) n = 189	Morbidity rate
1) North 1	1 (0.53)	0.02
Chiang Rai	1 (0.53)	0.08
2) North 2	1 (0.53)	0.03
Phitsanulok	1 (0.53)	0.12
3) Central 1	0	
4) Central 2	2 (1.06)	0.04
Lop Buri	2 (1.06)	0.26
5) West	0	
6) East	0	
7) Northeast 1	5 (2.65)	0.10
Kalasin	1 (0.53)	0.10
Khon Kaen	1 (0.53)	0.06
Roi Et	3 (1.59)	0.23
8) Northeast 2	151 (79.89)	2.74
Loei	120 (63.49)	18.85
Udon Thani	21 (11.11)	1.34
Nong Khai	7 (3.70)	1.35
Nong Bua Lam Phu	3 (1.59)	0.59
9) Northeast 3	13 (6.88)	0.19
Chaiyaphum	9 (4.76)	0.79
Nakhon Ratchasima	3 (1.59)	0.11
Buri Ram	1 (0.53)	0.06
10) Northeast 4	13 (6.88)	0.28
Mukdahan	9 (4.76)	2.59
Amnat Charoen	3 (1.59)	0.80
Si Sa Ket	1 (0.53)	0.07
11) South 1	1 (0.53)	0.02
Surat Thani	1 (0.53)	0.10
12) South 2	0	
13) Capital	2 (1.06)	0.04
Bangkok	2 (1.06)	0.04

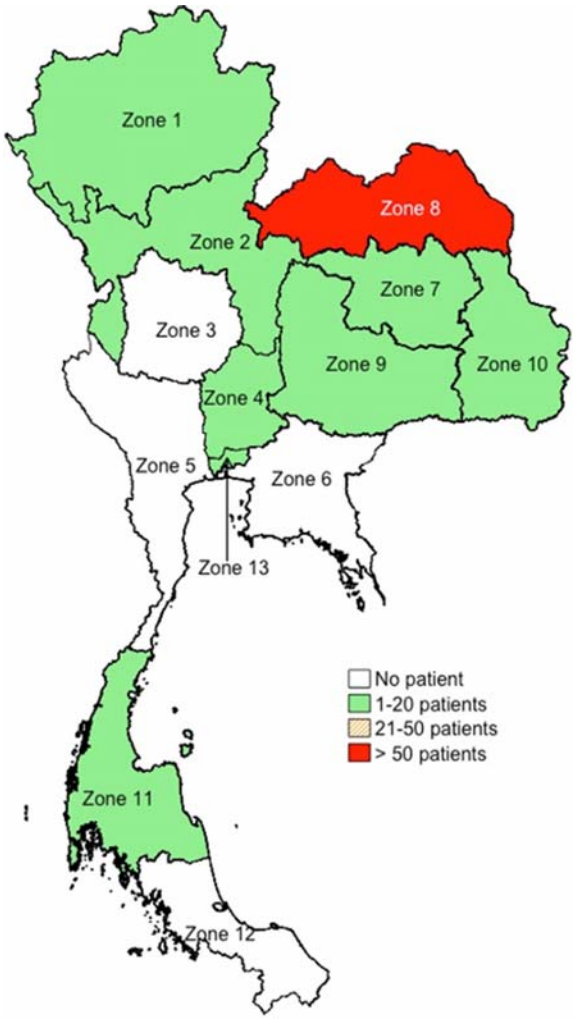

Figure 1. Showed numbers (by range) of patients with eosinophilic meningitis by public health zone in Thailand.

previously reported[2]. Habits of eating raw/uncooked/or partially cooked raw snails may be a major risk factor for eosinophilic meningitis in Thailand. Male farmers in northeastern Thailand have this habit during their routine rice farm works.

As mentioned above, the highest morbidity rate was 2.74/100,000 population from public health zone 8 (Northeast 2). Eosinophilic meningitis is highly prevalent in Loei province (Table 2). The reasons why Loei province had higher morbidity rate than other provinces in the northeastern provinces are not well understood. The possible explanation may be cultural or habitual consumptions of raw freshwater snails or shrimp in Loei province. Uncooked snails with alcohol or flavorings on local snail dish, called koi-hoi, may be accounted for A. cantonensis infection[5]. Further studies are needed to explore the high morbidity rate of eosinophilic meningitis in Loei.

Rainy and winter seasons were the common seasons for eosinophilic meningitis (83.60%). Farmers or agriculturists are working in the rice fields or farms during these two seasons particularly rainy season. They may consume raw or uncooked during their works at the fields. As previously reported, A. cantonensis was found in snails in the northeast and north of Thailand[6,7] such as *Pila polita*, or *Achatina fulica*. There are clinical case reports from consuming freshwater shrimp, monitor lizard, slugs, or playing with

Table 3. Distribution of patients with eosinophilic meningitis in Thailand (2017) by seasons categorized by age, sex, and provinces

Factors/seasons	Summer, n = 31	Rainy, n = 90	Winter, n = 68	Total, n = 189	*p*-value
Age group, years					0.820[a]
7 to 9	0	2 (2.22)	1 (1.47)	3 (1.59)	
10 to 14	0	1 (1.11)	1 (1.47)	2 (1.06)	
15 to 24	3 (9.68)	13 (14.44)	14 (20.59)	30 (15.87)	
25 to 34	4 (12.90)	20 (22.22)	12 (17.65)	36 (19.05)	
35 to 44	13 (41.94)	22 (24.44)	13 (19.12)	48 (25.40)	
45 to 54	7 (22.58)	19 (21.11)	19 (27.94)	45 (23.81)	
55 to 64	2 (6.45)	7 (7.78)	5 (7.35)	14 (7.40)	
≥65	2 (6.45)	6 (6.67)	3 (4.41)	11 (5.82)	
Sex					0.175[b]
Male	23 (74.19)	55 (61.11)	37 (54.41)	115 (60.85)	
Female	8 (25.81)	35 (38.89)	31 (45.59)	74 (39.15)	
Provinces					0.004[a]
Chiang Rai	0	1 (1.11)	0	1 (0.53)	
Phitsanulok	0	1 (1.11)	0	1 (0.53)	
Lop Buri	0	0	2 (2.94)	2 (1.06)	
Kalasin	1 (3.23)	0	0	1 (0.53)	
Khon Kaen	0	1 (1.11)	0	1 (0.53)	
Roi Et	1 (3.23)	2 (2.22)	0	3 (1.59)	
Loei	12 (38.70)	64 (71.11)	44 (64.71)	120 (63.49)	
Udon Thani	7 (22.57)	5 (5.55)	9 (13.24)	21 (11.11)	
Nong Khai	1 (3.23)	3 (3.33)	3 (4.41)	7 (3.70)	
Nong Bua Lam Phu	1 (3.23)	2 (2.22)	0	3 (1.59)	
Chaiyaphum	1 (3.23)	3 (3.33)	5 (7.35)	9 (4.76)	
Nakhon Ratchasima	1 (3.23)	2 (2.22)	0	3 (1.59)	
Buri Ram	1 (3.23)	0	0	1 (0.53)	
Mukdahan	5 (16.12)	1 (1.11)	3 (4.41)	9 (4.76)	
Amnat Charoen	0	3 (3.33)	0	3 (1.59)	
Si Sa Ket	0	0	1 (1.47)	1 (0.53)	
Surat Thani	0	1 (1.11)	0	1 (0.53)	
Bangkok	0	1 (1.11)	1 (1.47)	2 (1.06)	

Each cell except *p*-value presents frequency (percentage)
[a] = The *p*-value from Fisher's exact test; [b] = The *p*-value from Chi-squared test

frogs in children as well[8-12].

As A. cantonensis infection has been found in other continents such as USA or Brazil[13,14]. These epidemiological data may be useful for clinical evaluation or references. However, this study had some limitations. First, some reported cases of eosinophilic meningitis might be performed in suspected cases. This statement appear on the website of the Bureau of Epidemiology, Department of Disease Control, Ministry of Public Health. Second, the 506 reports are not from all hospitals in Thailand; some private hospitals do not currently report this form. Third, confirmatory test such as serology test for A. cantonensis is not widely available in hospitals in Thailand[15,16]. Finally, clinical data of each infected patient are not studied such as vectors of infection either freshwater snails or shrimp, or percentage of CSF eosinophils.

In conclusion, the northeastern part of Thailand particularly Loei province is still endemic for eosinophilic meningitis. The infection is more prominent in working-aged male in the rainy season.

What is already known on this topic?

Eosinophilic meningitis, caused by *Angiostrongylus cantonensis*, is endemic in Thailand.

What this study adds?

Eosinophilic meningitis in Thailand was

prominently found in working-age group (25 to 54 years), male (60.85%), and agriculturists (46.56%). It was reported mainly from northeastern Thailand (96.30%) with zero rates of mortality. There was a seasonal variation of numbers of patients with this disease.

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Potential conflicts of interest

The authors declare no conflict of interest.

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