

## Abstract

- Eosinophilic meningitis is a rare type of meningitis characterized by the presence of eosinophils in the cerebrospinal fluid (CSF).
- Parasites are known to be the most common cause of eosinophilic meningitis worldwide, but there is limited research on patients in South Korea.
- A total of 35 patients diagnosed with eosinophilic meningitis between January 2004 and June 2018 were retrospectively reviewed.
- Of the 35 patients, parasitic causes such as neurocysticercosis and toxocara meningitis were most common, followed by fungal meningitis and tuberculous (TB) meningitis. Viral and bacterial causes were relatively rare, while the cause could not be identified in approximately one third of the patients.
- One patient with neurocysticercosis and one patient with fungal meningitis died, and 23% of patients had neurologic sequelae.
- Parasite infections were the most common cause of eosinophilic meningitis in South Korea, but other causes such as fungi or TB should always be considered.

## Background

- Eosinophilic meningitis is a rare clinical entity in which eosinophilic pleocytosis is found in the CSF of patients with symptoms suggestive of meningitis.
- Parasites such as *Angiostrongylus cantonensis* and *Gnathostoma spinigerum* are known to be the most common causes of eosinophilic meningitis in regions such as North America, Southeast Asia, and the Caribbeans.
- However, there is limited research on the causes and characteristics of eosinophilic meningitis in South Korea.
- In this study, we aimed to aid in the diagnosis and treatment of patients with eosinophilic meningitis by identifying the common pathogens of the disease and comparing the characteristics of the patients according to their etiology.

## Methods

- We retrospectively reviewed the medical records of patients who received lumbar punctures between January 2004 and June 2018 at a tertiary referral hospital in Seoul, South Korea.
- Patients who met both of the following criteria were selected: (1) more than 10 eosinophils per mm<sup>3</sup> in the CSF or eosinophils accounting for more than 10 percent of leukocytes in the CSF; and (2) clinical symptoms and signs suggestive of acute meningitis
- Patients who were diagnosed with non-infectious diseases were excluded.

## Results

- A total of 35 patients were included in the final analysis, and their etiology were as follows: neurocysticercosis (n = 8, 23%), fungal meningitis (n = 4, 11%), TB meningitis (n = 4, 11%), toxocara meningitis (n = 3, 9%), viral meningitis (n = 2, 6%), bacterial meningitis (n = 1, 3%), and unknown etiology (n = 13, 37%)
- Neurocysticercosis was the most common etiology. The mean age of the patients was older than other groups, and gait disturbance was the most common symptom. Hydrocephalus was commonly seen on brain imaging. One patient died of the disease, while 63% had neurologic sequelae.
- Toxocara meningitis was diagnosed in 3 patients. All of the patients had a history of raw meat intake, with profound eosinophilic pleocytosis in the CSF. Peripheral blood eosinophilia was often seen, and there were no deaths or neurologic sequelae.
- Fungal meningitis was also significant. While all 4 patients had no history of prior immunodeficiency, 2 of them were children under the age of 15, and both were later diagnosed with CARD9 deficiency. One patient died due to the disease.
- TB meningitis was diagnosed in 11% of patients, probably since TB is endemic in South Korea. Lymphocytes were dominant in the CSF, with elevated protein and ADA levels. Meningeal enhancement and acute infarctions were commonly seen on brain imaging.
- Viral and bacterial meningitis were rare causes of eosinophilic meningitis, while the etiology could not be confirmed in 37% of patients.

## Results

Table 1. Clinical and radiologic characteristics of patients with eosinophilic meningitis according to different etiology

	Total N = 35	Neuro- cysticercosis N = 8	Toxocara meningitis N = 3	Fungal meningitis N = 4	Probable TB meningitis N = 4	Viral meningitis N = 2	Bacterial meningitis N = 1	Meningitis of unknown etiology N = 13
Age at diagnosis, years (mean ± SD)	38.4 ± 22.5	59.9 ± 11.2	33.7 ± 1.5	37.8 ± 30.1	40.0 ± 14.4	20.5 ± 12.0	0.5 ± 0	31.5 ± 22.9
Male sex	21 (60)	6 (75)	3 (100)	2 (50)	3 (75)	1 (50)	1 (100)	5 (39)
History of overseas travel	6 (17)	0 (0)	2 (67)	1 (25)	0 (0)	1 (50)	0 (0)	2 (15)
History of raw food ingestion	5 (14)	1 (13)	3 (100)	0 (0)	0 (0)	0 (0)	0 (0)	1 (8)
Symptoms or signs								
Headache	25 (71)	3 (38)	3 (100)	3 (75)	4 (100)	2 (100)	0 (0)	10 (77)
Vomiting	14 (40)	0 (0)	1 (33)	3 (75)	2 (50)	2 (100)	1 (100)	5 (39)
Fever	13 (37)	0 (0)	2 (67)	2 (50)	2 (50)	1 (50)	1 (100)	5 (39)
Cranial nerve palsy	3 (9)	0 (0)	0 (0)	1 (25)	0 (0)	0 (0)	0 (0)	2 (15)
Dizziness	5 (14)	1 (13)	0 (0)	0 (0)	2 (50)	0 (0)	0 (0)	2 (15)
Altered consciousness	11 (31)	1 (13)	0 (0)	1 (25)	2 (50)	0 (0)	0 (0)	7 (54)
Gait disturbance	7 (20)	4 (50)	0 (0)	1 (25)	1 (25)	0 (0)	0 (0)	1 (8)
Neck stiffness	7 (20)	1 (13)	1 (33)	1 (25)	2 (50)	1 (50)	0 (0)	1 (8)
CSF, median (range)								
WBC count (/μL)	90 (2–1000)	50 (2–270)	680 (120–1000)	195 (33–307)	162 (58–470)	22 (12–31)	45	57 (5–800)
Percentage of eosinophil in WBC (%)	18 (11–73)	16 (11–27)	54 (36–73)	19.5 (18–57)	17 (16–30)	28 (11–44)	16	20 (10–71)
Protein level (mg/dL)	82.9 (22.6–1042.7)	89.3 (29.7–134.9)	66.8 (44.7–83.1)	88.4 (59.6–134.7)	160.3 (73.6–251.5)	49.1 (42.6–55.5)	178.7	55.9 (22.6–1042.7)
Glucose level (mg/dL)	52 (2–91)	52 (13–79)	55 (49–68)	44 (35–52)	39 (9–61)	62 (61–63)	46	52 (2–91)
Peripheral blood eosinophilia	10 (29)	0 (0)	3 (100)	1 (25)	1 (25)	1 (50)	0 (0)	4 (31)
Brain imaging findings								
Meningeal enhancement	18 (51)	2 (25)	1 (33)	3 (75)	4 (100)	0 (0)	1 (100)	7 (54)
Hydrocephalus	8 (23)	7 (88)	0 (0)	1 (25)	0 (0)	0 (0)	0 (0)	0 (0)
Acute infarction	4 (11)	0 (0)	0 (0)	2 (50)	2 (50)	0 (0)	0 (0)	0 (0)
Treatment with steroids	23 (66)	5 (63)	3 (100)	4 (100)	3 (75)	0 (0)	0 (0)	8 (62)
Deaths	2 (6)	1 (13)	0 (0)	1 (25)	0 (0)	0 (0)	0 (0)	0 (0)
Neurologic sequelae	8 (23)	5 (63)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (23)

CSF, cerebrospinal fluid; SD, standard deviation; TB, tuberculosis; WBC, white blood cell. Values are n (%) unless noted otherwise

## Conclusions

- Parasite infections such as neurocysticercosis and toxocariasis were the most common causes of eosinophilic meningitis in South Korean patients. Elderly patients with eosinophilic meningitis should undergo brain imaging and be screened for cysticercus antibodies, while patients with a history of raw meat intake, eosinophilic pleocytosis in the CSF, and peripheral blood eosinophilia should be tested for toxocara antibodies.
- Other etiologies included fungi, TB, bacteria and viruses. Epidemiological risk factors should be taken into account when searching for the cause of eosinophilic meningitis.
- While the proportion of fungal meningitis is not high, it should not be ignored considering its high mortality rate. The results of this study suggest that fungal eosinophilic meningitis could be the presenting infection of an inherited immune deficiency condition in previously healthy children.