RESEARCH NOTE

A probable outbreak of toxoplasmosis among boarding school students in Turkey

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ABSTRACT

In total, 171 students from a boarding school in Izmir, Turkey, with mild and non-specific symptoms of toxoplasmosis, were screened during September–October 2002. All 171 students were seropositive for *Toxoplasma gondii* IgG and IgM. Of 43 students tested, 40 (93%) had low IgG avidity. None showed evidence of ophthalmic involvement. The data suggest that *T. gondii* may spread rapidly in close living conditions, possibly following exposure to cat litter. This is the largest recent outbreak of toxoplamosis described in the medical literature.

Keywords Cat exposure, diagnosis, epidemiology, outbreak, serological tests, toxoplasmosis

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Most human infections caused by *Toxoplasma gondii* follow a benign course in immunocompetent subjects. However, there are several reports concerning outbreaks of toxoplasmosis in the last two decades [1–7], including outbreaks associated with a municipal water supply [6], consumption of uncooked pork [1], and exposure to domestic cats [7]. In a boarding school in Izmir, Turkey, the school authorities and regional physicians noted a sudden onset of minor symptoms in students, such as cervical lymph node enlargement and low-grade fever, during September 2002. Initially, 171 of 1797 students, aged 14–18 years, had symptoms at the beginning of September 2002. All 1797 students underwent physical examination, including repeated ophthalmological evaluations. Symptoms were mostly flu-like complaints (sub-febrile fever, myalgia, dizziness, headache) with or without marked cervical lymphadenopathy. None of the subjects had chorioretinitis or other ophthalmological pathology. Sera obtained from the 171 students with symptoms were screened for antibodies to *Toxoplasma* by IgM and IgG ELISAs. IgG antibodies to *T. gondii* were detected by ELISA IgG (Equipar, Saronno, Italy), and IgM was detected by ELISA IgM (Equipar) and by an automated assay (VIDAS TOXO IgM; bioMérieux, Lyon, France), according to the instructions of the respective manufacturers. ELISA IgG and IgM results were expressed in TOXO IgG/TOXO IgM indices (> 1 positive; < 1 negative), while VIDAS IgM results were expressed in VIDAS IgM indices (< 0.65 negative; > 0.65 positive). Randomly selected students from among those yielding positive results were also tested after 4 weeks for *T. gondii* IgG avidity (Beia IgG; Bouty, Milan, Italy). Values < 15% indicated low avidity; values of 15–25% were considered to represent borderline avidity; and values > 25% indicated high avidity.

All statistical analyses were performed using SPSS v.10.0 (SPSS Inc., Chicago, IL, USA). Arithmetic mean ± standard deviation notation was used for the descriptive statistics. Since some of the data were not distributed normally, logarithmic transformation was used when appropriate. Pearson's correlation coefficient was used to investigate the relationship among the variables. A linear regression model was used, with p values ≤ 0.05 regarded as statistically significant.

Based on the serological tests, all 171 students were seropositive for *T. gondii* by ELISA IgG/IgM and VIDAS IgM. Among the randomly selected subjects (Table 1), 40 (93%) of the 43 tested subjects had low IgG avidity, and only three (6.9%) had discrepant IgG avidity. All of the subjects had lymphadenopathy in the cervical/sub-mandibular/retro-auricular/sub-occipital regions, *c.* 1 × 1.5 cm in size, which was present in 25%, 36%, 4% and 34% of subjects, respect-

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Table 1. Serological test results for *Toxoplasma gondii* among 56 randomly selected subjects

No. of subjects	ELISA IgM[a]	ELISA IgG[b]	VIDAS IgM[c]	IgG avidity (%)[d]
1	3.9	4.7	4.73	14
2	4.4	6.7	5.01	20
3	5.2	3.1	6.18	ND
4	3.4	4.7	2.54	7
5	5.1	4.7	8.54	6
6	5.1	5	6.43	9
7	4.7	6.8	3.19	24
8	4.1	4.9	3.39	6
9	2.5	4.3	2.63	6
10	1.8	4	2.16	5
11	4.6	6.2	6.27	12
12	3.2	6.2	3.36	10
13	2.3	4.2	2.43	7
14	5.7	4.9	9.12	9
15	4.8	3.7	4.77	6
16	2.1	4.5	2.42	2
17	2.1	5.5	2.61	10
18	3.3	3.7	4.13	3
19	3.5	4.5	2.99	5
20	2.6	4	2.92	4
21	4.5	4.2	6.43	4
22	4.4	4	4.57	7
23	3	3.9	1.95	4
24	5.1	4.2	6.87	4
25	5	5	6.44	7
26	5.3	5	5.45	10
27	4	4.4	5.32	5
28	3.7	6.1	4.64	21
29	3.1	3.5	3.18	3
30	2.7	2.6	2.99	3
31	5.4	3.8	8.52	5
32	5	5.7	4.16	10
33	1.8	4	1.81	5
34	5.1	5.3	5.56	14
35	4	3	3.38	ND
36	5.4	6	8.65	9
37	3	5.6	3.44	7
38	3.9	5.3	5.87	4
39	4.3	6.1	5.08	14
40	3.6	5.4	3.17	13
41	5	4.7	6.03	5
42	2.8	4.1	2.53	7
43	2.9	6.1	2.88	10
44	4.6	3.2	5.87	6
45	1.7	5	1,41	6
46	4.7	3.3	5.6	ND
47	5.3	1.3	8.95	ND
48	3.5	5.1	3.91	ND
49	3.5	2.3	4.14	ND
50	5.4	5.8	6.54	ND
51	4.1	5.2	3.71	ND
52	3.4	5.5	3.96	ND
53	4.6	2.8	6.91	ND
54	4.9	3.7	8.15	ND
55	3	4.8	3.14	ND
56	3.8	5.1	5.73	ND

[a]Positive > 1.
[b]Positive > 1.
[c]Positive > 0.65.
[d]< 15% low avidity; 15–25% borderline avidity; > 25% high avidity.
ND, not done.

ively. None of the students had evidence of an active chorioretinitis following retinal examination by an ophthalmologist. Most of the subjects belonged to the junior grade of the boarding school. Correlations between ELISA IgM and VIDAS IgM (r = 0.859; p < 0.001), ELISA IgM and IgG avidity (r = 0.326; p 0.033), ELISA IgG and IgG avidity (r = 0.775; p < 0.001) were significant.

Outbreaks of toxoplasmosis caused by *T. gondii* are reported rarely. The incidence of acute toxoplasmosis in Turkey is not particularly high, although there are high seropositivity rates. Thus, 431 (23.1%) of 1865 individuals, aged 3–82 years, who were resident in Izmir and the surrounding rural area, had IgG antibodies against *T. gondii* [8]. The city of Izmir is located in western Turkey, and forms an urban area that has had no known history of significant foodborne or waterborne epidemics of infection for many years.

The lymphadenopathic form of toxoplasmosis in immunocompetent adults is usually a benign infection that does not need any treatment, unless visceral involvement is clinically overt or symptoms are severe or persistent [9]. Acquired acute *T. gondii* infection is a common cause of asymptomatic lymphadenopathy in immunocompetent adults and has a very mild course. Although food and drinking water are often implicated, it is usually difficult to determine the precise focus of infection. In adults, infection occurs most commonly through the ingestion of raw or undercooked meat that contains cysts, or through the ingestion of oocysts in contaminated water or food [7–9]. The large number of individuals who are seropositive for *T. gondii* suggests that most infections are not severe, as most seropositive individuals exhibit few (e.g., lymphadenopathy, fever) or no symptoms [10]. In the present epidemic, acute toxoplasmosis was confirmed by the presence of anti-*T. gondii* IgG and IgM. As the patient group consisted of otherwise healthy students with a normal immune status, no therapy was initiated [9–11].

The precise cause of the outbreak of toxoplasmosis in the boarding school remains a mystery. No common source (drinking water, food or event) was identified. No *T. gondii* oocysts could be found in the soil surrounding the school, although there was a sheltering place for a large number of stray cats near the dining hall of the junior-grade students. In this outbreak, junior-grade students accounted for 88% of the overall seropositivity at the end of the investigation (data not shown), and the risk of transmission was reduced in other student grades that were using different dining halls. Other studies have shown that restricted room space promotes transmission. The school authority removed the cats immediately, i.e., before they could be investigated for toxoplasmosis. Follow-up visits to the school

were continued on a periodic basis, with serological and physical examinations. After 2–6 months, a significant decrease in ELISA IgG/IgM, and VIDAS IgM titres was observed (data not shown). No complications other than a transient mild hypogonatrophic hypogonadism [12] in 14 students has so far been noted.

There is a requirement for more inclusive and accurate population-based data concerning the incidence of toxoplasmosis and the number of cases with respect to different transmission modes. The development of assays that would facilitate tracing the source of individual infections, e.g., soil, drinking water, food or cats, would assist in determining the best approaches for interventions [13].

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RESEARCH NOTE

Application of microsatellite typing for the investigation of a cluster of cases of *Candida albicans* candidaemia

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ABSTRACT

A cluster of cases of *Candida albicans* candidaemia in a surgical intensive care unit was investigated. The probability of such a cluster during a single month was highly significant compared with the frequency of candidaemia in the previous year. A molecular typing method, based on length analysis of three (EF3, CDC3, HIS3) microsatellite-containing regions, was used to investigate isolates from patients in and outside the ward. This demonstrated the involvement of different strains, indicating the absence of cross-transmission among patients. Results of microsatellite typing can be obtained almost in real-time, which is particularly useful in an outbreak context.

Keywords *Candida albicans*, candidaemia, microsatellite repeats, molecular typing, outbreak, typing

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