Follow-up of the 1977 Georgia Outbreak of Toxoplasmosis

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Abstract. In 1977, an outbreak of toxoplasmosis occurred among 37 persons associated with exposure to an indoor horse arena. Cat feces containing the organism were most likely stirred up when horses ran on the dirt floor, and were inhaled or ingested by riders and observers. After 25 or more years, we attempted to locate persons from the outbreak and offer them an eye examination. Of the 37 persons in the outbreak, 18 (49%) were located; four had died, and the remaining 14 agreed to an examination. Among the 14 persons examined, three (21%) were found to have lesions typical of toxoplasmic retinochoroiditis. If these three persons were the only ones with ocular disease among the 37 persons in the outbreak, the disease rate would still be high (8%). As a result of exposure to *Toxoplasma gondii* during this outbreak, a relatively high percentage of persons developed ocular disease.

An outbreak of *Toxoplasma gondii* infection occurred in Georgia among individuals who had been in an indoor horse arena, and was presumed to be caused by inhalation or ingestion of dust contaminated by cat feces and stirred into the air by horses running on the dirt floor.¹ Among 37 people thought to be infected with *T. gondii* as a result of the outbreak, 36 (98%) had serological evidence of recent infection (high IgG indirect fluorescent-antibody test [IFA; $\geq 1:4,096$] or positive IgM IFA [$\geq 1:16$] titers), and at least 33 individuals (89%) had symptoms typical of toxoplasmosis (fever, headache, or lymphadenopathy).¹ Although symptoms were nonspecific, an epidemiological study found that the prevalence of symptoms was significantly higher in case patients than in appropriate controls. Studies of the outbreak have been described in several subsequent publications.^{1–5}

Follow-up ocular examinations were performed on 17 infected individuals 1 year after the outbreak; none had evidence of ocular disease, and none of the remaining 20 individuals were known to have ophthalmic symptoms.⁵ Subsequent follow-up ocular examinations were performed on 25 individuals 4 years after the outbreak; one person had a single lesion consistent with toxoplasmic retinochoroiditis in the right eye.⁵ After treatment with antimicrobials and corticosteroids, the lesion resolved, leaving a chorioretinal scar.

The high prevalence of systemic signs and symptoms at the time of the outbreak was postulated to be due to an infection caused by oocysts rather than tissue cysts,⁴ and suggests that the outbreak was caused by a virulent strain of *T. gondii*. It has been shown that people might develop ocular disease years after postnatal infection with virulent strains of the parasite.⁶ We therefore initiated a study to determine the proportion of persons infected during the outbreak who developed clinically apparent toxoplasmic retinochoroiditis since the last follow-up examinations in 1981, and to describe the nature of those lesions, if any.

In 2002, approximately 25 years after the initial investigation, we again sought to conduct follow-up examinations on as many of the 37 people infected during the outbreak as possible. Questionnaires from the original 1977 investigation

of the outbreak, sponsored by the Centers for Disease Control and Prevention (CDC), had been stored in a locked file cabinet at CDC; they contained names, addresses, and telephone numbers of those interviewed during the outbreak, and from these records, we attempted to locate each infected individual directly, through internet searches, or through family members. Each of those located was offered an ocular examination, at no cost to the individual, by an ophthalmologist with specialized training in uveitis or retinal diseases as close as possible to the individual's residence. Those who agreed to participate completed a new questionnaire regarding ocular problems and general health history. Written consent was obtained before providing individuals with the questionnaire and before ocular examinations were performed. Examination results were recorded on standardized forms, and fundus photographs were obtained of all lesions identified on examination. Photographs were reviewed by an additional individual with expertise in ocular toxoplasmosis (Gary N. Holland) to confirm that lesions were consistent with active or healed toxoplasmic retinochoroiditis. All examinations were completed by 2005, after which no additional individuals could be located. The study was approved by the CDC Human Subjects Review Committee and by the Human Subject Protection Committee of the University of California, Los Angeles.

Of the 37 individuals infected in the 1977 outbreak, we located 18 (49%); 14 (38%) agreed to participate, and the remaining four (11%) were deceased. Of the 14 examined, 13 (93%) were female; the median age in 1977 was 16 years (range 10–47 years); and the median age at the time of reexamination was 42.5 years (range 35–72 years). Of the 23 not examined, 19 (83%) were female, and median age in 1977 was 27 years (range 17–38 years). Of the 14 individuals who were reexamined in our study, three (21%) had lesions typical of toxoplasmic retinochoroiditis, including the individual with ocular toxoplasmosis at the 4-year follow-up examination. The three individuals were related (two siblings, one of whom had the previously identified lesion, and their mother). The two individuals with newly identified lesions never had symptoms of ocular disease, supporting the notion that initial ocular involvement might be asymptomatic.

The individual with ocular toxoplasmosis at the 4-year follow-up examination (1981) was found on reexamination (2003) to have a retinochoroidal scar (Figure 1) that was

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FIGURE 1. A chorioretinal lesion, consistent with an inactive toxoplasmic retinochoroidal scar, in the right eye of a person infected by *Toxoplasma gondii* 26 years earlier during an epidemic. Other than being more pigmented, the scar appears to be unchanged from its appearance 4 years after infection in 1981, as documented by Akstein and others.⁵

identical in size and location to the original lesion found in 1981 by Akstein and others⁵; although the lesion was more heavily pigmented (consistent with the course of such scars), there was no evidence of reactivation during the intervening 22 years. In addition, she had a smaller, chorioretinal scar in the superotemporal periphery, remote from the original lesion, which was not documented during the 4-year follow-up examination, suggesting a later, asymptomatic recurrence. The other two individuals each had single, inactive retinochoroidal scars in the periphery; one had a circular, well-demarcated lesion, approximately 0.7 disc diameter in greatest dimension, with pigmented borders, located inferior to the macula in the right eye, whereas the other had an elongated lesion with reticular pigmentation in the inferotemporal quadrant of the left eye.

In summary, a substantial percentage (21%) of those reexamined had developed ocular toxoplasmosis during the 28 years after the outbreak. If the three people found to have ocular lesions were the only individuals among the 37 persons infected during the outbreak, the prevalence of ocular involvement would still be relatively high (8%), considering estimates that only 2% of *T. gondii*-infected individuals in the United States have ocular involvement.⁷ Higher proportions of ocular involvement during outbreaks are believed to result from infection with more virulent strains of *T. gondii*.⁸ Because of the institutional review board policies implemented at the CDC since 1977, we did not receive approval for obtaining patient serum samples during the follow-up study, which might have provided information about strain types. Notable is the fact that the three individuals with ocular involvement are members of an immediate family. It is possible that these three individuals, who were at the

riding stable, were exposed to a higher dose of *T. gondii* oocysts; alternatively, certain hosts might have a genetic predisposition to more extensive or severe disease. This report therefore underscores the need to study the role of host factors in the pathogenesis of ocular toxoplasmosis in addition to the need for long-term follow-up of individuals affected by outbreaks of *T. gondii* infection.

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