INTRODUCTION

Toxoplasmosis represents an important public health problem, considering that 0.25–5 cases of congenital infection occur per 1000 live births; that approximately 10 to 20% of uveitis cases are caused by this parasite; and that the prevalence of *Toxoplasma gondii*-induced encephalitis can reach up to 40% in patients with AIDS (Krick & Remington, 1978; Frenkel, 1973; Luft & Remington, 1988). Therefore, toxoplasmosis is of great clinical importance in man in two major situations: as a cause of congenital infection, with 5–24% of children becoming ill and dying during the neonatal period, in addition to the high rate of children with severe physical, neurological and visual sequelae who require special education and costly care (Frenkel, 1973; Remington & Desmonts, 1990), and as an opportunistic infection with high mortality in immunosuppressed individuals (Carey et al., 1973; Ambroise-Thomas & Pelloux, 1993).

Toxoplasmosis can vary from an asymptomatic, self-limiting infection to a fatal disease, as seen in patients with congenital infections or in debilitated patients in whom underlying conditions may influence the final outcome of the infection (Ambroise-Thomas & Pelloux, 1993).

In individuals with normal immunity and acute acquired *Toxoplasma*, infection is usually self-limiting and rarely requires specific treatment (Israelski & Remington, 1993). In immunocompetent hosts, the infection is frequently benign, with parasitaemia being self-limiting, resulting in an asymptomatic clinical form of the disease in most cases. However, in about 20% of *Toxoplasma* cases, acute infection is accompanied by febrile lymphadenopathy, asthenia and lymphomonomocytosis, with the course of infection being self-limited (Feldman, 1968; Darcy & Santoro, 1994). After this period, *T. gondii* remains viable in the form of tissue cysts, which reproduce slowly throughout the life of the host, thus characterizing the chronic phase of infection. During this phase, the tissue cysts are controlled by the humoral and cellular immune system, involving T-lymphocytes and macrophages, which are continuously stimulated by parasite antigens. As a result, parasite multiplication is more active and persists for longer periods of time in less immunologically active tissues such as the central nervous system (Darcy & Santoro, 1994; Sims et al., 1989).

Immunocompromised hosts, especially those with deficient cellular immunity, are at risk of recurrence of chronic infection and dissemination, with the occurrence of fulminating disease. Patients with neoplasia, collagen tissue disease, transplant recipients under immunosuppressive therapy or haemodialysis patients with chronic renal failure have deficient cellular immunity, and this makes them susceptible to the infection (Yazar et al., 2003). In immunocompromised patients, the infection most often involves the nervous system, with diffuse encephalopathy, meningoencephalitis or cerebral mass lesions (García & Bruckner, 1997).

The most frequent protozoan causing opportunistic infections in immunocompromised individuals is *T. gondii*. Its association with severe manifestations of immunosuppression has been known for several decades, and the occurrence of encephalitis and disseminated disease has since been observed in different clinical conditions such as lymphoreticular neoplasias, solid organ transplants, and at present, mainly in patients with AIDS (Ferreira & Borges, 2002).

Toxoplasmosis in patients who are immunocompromised by virtue of underlying neoplastic disease has received relatively little attention. In this study, the seropositivity rate of anti-
T. gondii antibodies in patients with neoplasia was evaluated. This patient group was immunocompromised because of the underlying disease and/or immunosuppressive therapy so they were at risk from opportunistic infection. The aim of this study was to assess the risk of severe toxoplasmosis in patients with neoplasia by monitoring IgG and IgM antibodies to T. gondii.

METHODS

Subjects. One hundred and eight (51 men, 57 women) patients with neoplastic disorders who presented to Erciyes University Medical Faculty Oncology and Haematology Department in 2000–2002 and 108 healthy volunteers (52 men, 56 women) were included in the study. The age of the patient group was 18 to 82 with the mean age of 50.9 ± 13.9 and 27 to 64 with the mean age of 51.9 ± 12.2 in the control group. Blood was taken from all patients under sterile conditions and was centrifuged at 1000 r.p.m. and the sera separated. The sera were stored at −20 °C until tested.

Serological technique. ELISA was used for determination of anti-T. gondii IgG and IgM antibodies. The ELISA kit was provided by a commercial manufacturer (EUROIMMUN). This procedure was performed according to the manufacturer’s instructions. Peroxidase-labelled anti-human IgG (rabbit) was used and the cut-off value recommended by the manufacturer of 10 IU ml⁻¹ for the detection of IgG was used. Peroxidase-labelled anti-human IgM (goat) was used for the detection of IgM antibody. The cut-off of the IgM ELISA kit was used. The absorbance of serum samples was divided into the absorbance of the calibrator, if the ratio was ≥1 the sample was considered as positive for IgM antibody.

Statistics. SPSS version 9.0 for Windows pocket program was used. Chi-squared test and Kolmogorov–Smirnov one sample test were used. \( P < 0.05 \) was accepted as statistically significant.

RESULTS AND DISCUSSION

IgG antibodies to T. gondii were found by ELISA in 68 (63.0 %) patients with neoplasia and in 21 (19.4 %) healthy volunteers. IgM antibodies were found by ELISA in seven patients (6.5 %) with neoplasia and in one healthy volunteer (0.9 %) in the control group. The sero-prevalence distributions of the two groups are shown in Table 1. The difference in the IgG seropositivity rate between the patient and the control group is statistically significant (\( P < 0.05 \)). The seropositivity rate of anti-T. gondii IgM was higher in the patient group but statistically significant (\( P < 0.05 \)) (Table 1).

The distribution of the neoplasia amongst the patient group and the seropositivity rates of anti-T. gondii IgG and IgM are shown in Table 2. We found the seropositivity rates of anti-T. gondii IgG in Hodgkin’s lymphoma, non-Hodgkin’s lymphoma, leukaemia, multiple myeloma, lung carcinoma, larynx carcinoma, hepatocellular carcinoma, breast cancer, ovarian cancer and their ratios were as follows: 68.0, 60.0, 66.7, 73.3, 38.5, 50.0, 80.0, 80.0, 80.0 and 63.0 %, respectively. We performed statistical analysis to determine the positivity rates of anti-T. gondii IgG antibodies in each neoplasia patient group. The results were not statistically significant (\( Z = 1.024, P > 0.05 \)).

Serological results are normally used to diagnose toxoplasmosis. All other procedures’ results must be interpreted in light of the serological findings. The Sabin–Feldman dye test, one of the first methods used to diagnose toxoplasmosis, is based on the fact that T. gondii, in the presence of immune serum, loses its affinity for methylene blue stain. Because this test uses live Toxoplasma trophozoites, however, most patients with severe toxoplasmosis are already infected with T. gondii by the time the test is performed.
laboratories do not provide it routinely. The serologic diagnosis of toxoplasmosis is very complex and has been discussed extensively in the literature; a number of additional procedures, some of which are automated, have been developed and reported in the last few years. These methods include enzyme immunoassays, some of which are automated, ELISAs, direct agglutination, an immunofluorescence assay (IFA), immunocapture and immunoblot. The ELISA is the method used most routinely because of its efficacy, ease of use, and its low cost and availability (Garcia & Bruckner, 1997).

The diagnosis of acute toxoplasmosis is mainly based on a combination of clinical and laboratory data. In clinical practice, serological tests are routinely employed to detect IgM- and IgG-specific antibodies, including indirect immunofluorescence and immunoenzymic tests. The use of more sensitive and specific methods, such as PCR, has been shown to be effective (Ferreira & Borges, 2002).

It is known that T. gondii infection produces IgM, IgA, IgE, and IgG antibodies, with the first three being detected early during the course of infection. IgM antibodies indicate acute infection, are the first to occur and can be detected 7–15 days after infection, with maximal concentrations being observed during the second month, followed by a progressive decline and disappearance of these antibodies within a few months. However, low antibody titres may persist for a prolonged period of time (months or years). IgG antibodies indicate chronic infection and an increased titre of IgG antibodies might show reactivation (Ferreira & Borges, 2002).

We evaluated the seropositivity rate of toxoplasmosis in patients with neoplasia, using ELISA to determine levels of anti-T. gondii IgG and IgM antibodies. The present results revealed higher percentages of positivity for T. gondii IgG and IgM antibodies in patients with neoplasia (52.9%) compared with the controls (20%) with a statistically significant difference (Table 1). These findings may be due to the fact that patients with neoplasia are immunocompromised, which increases their susceptibility to this infection.

It has recently been shown that the seropositivity rate of patients with neoplasia (65.5%) was statistically higher than the control group (Hökelek et al., 2001). In addition, studies indicated that the seropositivity for IgG of patients with Hodgkin’s and non-Hodgkin’s disease was 42.8% (Altintas, 1983) and in acute leukaemia patients was 63.3% (Güngör et al., 1993). Our results also agreed with these studies.

The immune system functions are disturbed in patients with neoplasia. This is the main reason for the high seropositivity results. Toxoplasmosis has been most often described in association with some specific malignancies such as Hodgkin’s disease, lymphoma, acute and chronic leukaemias or multiple myeloma. Moreover, patients being treated with anti-neoplastic agents for solid tumours including those of the breast, ovary and lung have been associated with toxoplasmosis. The mechanisms by which these diseases predispose to development of toxoplasmosis have not been well characterized. Whether it is the disease itself or the immunosuppressive therapy used for its treatment that it is of greater importance in suppressing immunity against Toxoplasma is unclear. However, these diseases are associated with defects in cell-mediated immunity, and it is clear that T-cell dysfunction, when augmented by the use of immunosuppressive therapies, predisposes to the development of toxoplasmosis (Israelski & Remington, 1993).

Individuals under immunosuppressive therapy such as patients with neoplasia, who had been previously infected with T. gondii, might show an altered serological profile for this protozoan compatible with reactivation, such as increased IgG antibody titres or, less frequently, increased titres of acute-phase antibodies thus, the patients with neoplasia may undergo acute reactivation. In the routine serological survey of cancer patients, results compatible with reactivation or acute infection could influence the treatment protocol. Severe toxoplasmosis can be prevented by therapy and, if necessary, a change in the chemotherapy protocol. The results of our study clearly support this interpretation.

In conclusion, patients with neoplasias should be screened for Toxoplasma routinely. Clinicians should be more careful with this patient group and parasitological surveys of patients with neoplasia should be periodically performed to prevent the possibility of severe toxoplasmosis.

REFERENCES


