

DIRECT GENOTYPING OF *TOXOPLASMA GONDII* IN BLOOD SAMPLES FROM PREGNANT WOMEN IN JAZAN, SAUDI ARABIA

By

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Abstract

Toxoplasma gondii (*T. gondii*) is divided three main clonal lineages designated as type I, II, and III and atypical genotypes were also detected. The distribution of *T. gondii* genotypes varied from one geographic area to another. This study characterized of *T. gondii* isolates from pregnant women in Jazan. Genetic analysis of the GRA6-coding fragment was performed for *T. gondii* genotyping using PCR-RFLP method. The seropositive for *Toxoplasma*-specific antibodies were determined using ELISA and were 27.9% in pregnant women in Saudi Arabia. Women seropositive for *Toxoplasma* IgG & IgM (GI=30) and for specific IgG (GII=30) were included.

Among pregnant women, 83.3% of GI (women seropositive for IgG and IgM) and 90% of GII (women seropositive for IgG) were asymptomatic and observed clinical symptoms were fever (n=4) and cachexia (n=2) and lymphadenopathy (n=1). GRA6-nested PCR was positive in 8 blood samples (13.3%), 5 of GI & 3 of GII seropositive women. RFLP analysis showed the detection of genotype I in 8 samples with no cases coinciding to pattern of type II or type III.

Key words: Saudi Arabia, Jazan, Pregnant women *T. gondii*, genotypes, GRA6, PCR-RFLP.

Introduction

Toxoplasma gondii (*T. gondii*) is an apicomplexan parasite that is an important protozoan in human and distributed widely in the world (Hill and Dubey, 2002). Human infection occurs by ingesting food and water contaminated with oocysts from cat feces or by ingesting undercooked meat containing cysts. In acute of infection, the *T. gondii* tachyzoite multiplies rapidly within the parasitophorous vacuole. In chronic infection, *T. gondii* forms tissue cysts in the muscles and brain and continue to divide slowly (Montoya and Liesenfeld, 2004; Dubey, 2009). One-third of human population was observed *T. gondii* seropositive (Tenter *et al*, 2000). Most cases of *Toxoplasma* infections in adults are asymptomatic, however number of patients experience lymphadenopathy and/or ocular toxoplasmosis in adults. Acquired *Toxoplasma* infection during pregnancy may lead to congenital disorder in the newborn (Weiss *et al*, 2009). In immunocompromised patients, toxoplasma infection may lead genotype to reactivation of *T. gondii* cyst in the brain, encephalitis (Abgrall *et al*, 2001).

Toxoplasma gondii was described as 3 clonal lineages, named types I, II, and III. *T. gondii* I is virulent, whereas types II & III are avirulent (Sibley and Ajioka, 2008). Virulence of genotype I strains may be due to overstimulation of a Th1 immune response and led to pathogenic changes in involved tissues (Mordue *et al*, 2001). Genotypes not related to three main lineages were considered atypical or exotic strains (Dardé, 2008). Atypical strains show various virulences i.e., highly virulent, intermediate and non-virulent phenotype (Grigg and Suzuki, 2003; Dardé, 2008). Genotype I strains was seen in immunocompromised patients including in AIDS and recurrent ocular toxoplasmosis (Howe and Sibley, 1995; Grigg and Boothroyd, 2001). In human toxoplasmosis, there is debate about the correlation between *T. gondii* genotype and disease consequences (Boothroyd and Grigg, 2002; Saeij *et al*, 2005). The investigation of genetic diversity of *T. gondii* isolates is insufficient in human. GRA6 PCR-RFLP technique could easily characterize three different groups of *T. gondii* strains and atypical genotypes (Owen and Trees, 1999; Fazaeli *et al*, 2000).

In Saudi Arabia, *T. gondii* is zoonotic endemic parasite in man, animals and birds (Al-Harthi *et al*, 2006; Sand and Al-Ghabban, 2007). But, little data about *T. gondii* genotypes was reported (Elamin *et al*, 2014).

In present study, *GRA6* PCR-RFLP technique was performed for characterization of *T. gondii* isolates from pregnant women.

Subjects, Materials and Methods

The present study was conducted at the Parasitology Laboratory, Faculty of Medicine, Jazan University. Peripheral blood was collected aseptically from 226 pregnant women in outpatient clinic, Jazan General Hospital from December 2014 to May 2015. For *Toxoplasma* antibodies 5ml of venous blood was collected and serum was separated by centrifugation at 3000 rpm for 10 min. at room temperature. *Toxoplasma*-specific IgG & IgM were determined by using ELISA Kits (Biocheck Inc., CA, USA) according to the manufacturer's protocol.

Sixty seropositive pregnant women were only included and divided into 2 groups: GI: 30 women seropositive for both *Toxoplasma*-specific IgM & IgG. GII: 30 women seropositive for specific IgG, but without IgM antibodies (Montoya and Remington, 2008).

The remaining whole blood was frozen at -20°C until transferred to Egypt for DNA extraction followed by nested PCR. Multiplex PCR was done to amplify the coding region of the *GRA6* gene (Lecordier *et al*, 1995). Nested PCR was done at Biotechnology Center, Ain Shams University. Genomic DNA was extracted from anti-coagulated blood samples using Puregene Kit (Gentra Systems Inc, USA) according to manufacturer's protocol. Oral consent was taken from women and clinical symptoms were registered.

Genotype analysis: Primers used for amplification of the coding region of the *GRA6*

gene are listed (Tab. 1; Zakimi *et al*, 2006). Briefly, first-round PCR was done using 25 µl reaction volume of 12.5µl DreamTaq® Green Master Mix (Fermentas, USA), 0.25 µl forward external primer, 0.25µl reverse external primer, 5µl DNA extract & 7µl nuclease-free water. Amplification was done in a first cycle using the cycling conditions: Denaturation at 94°C for 5 min, 35 cycles of denaturation at 94°C for 30s, annealing at 54°C for 60s, and extension at 72°C for 90s, and then extension step at 72°C for 7 min. A second amplification was performed using 1µl of 1:10 diluted PCR products in nuclease-free water from the first amplification reaction. A second-round PCR was carried out in a reaction mixture consisting of 25µl of DreamTaq® Green Ma-ster Mix (Fermentas, USA), 0.5µl of forward internal primer, 0.5µl of reverse internal primer, 10µl of diluted PCR product and 14µl of nuclease-free water. The steps of PCR amplification was done using the following cycling condition: An initial denaturation at 94°C for 5 min, 35 cycles of denaturation at 94°C for 30s, annealing at 60°C for 60s, and extension at 72°C for 90s, and then a 7-min extension step at 72°C. The 2% agarose gel was used to analyze amplified PCR products and molecular weight marker (100 base pair DNA ladder, Bioron, Germany). Positive DNA control included in each PCR set was extracted from *T. gondii* RH strain (gift from Medical Research Institute, Alexandria) and a negative control was nuclease-free water. *Toxoplasma* control positive DNA template was prepared (Lin *et al*, 2000). Tachyzoites acquired from peritoneal lavage of experimentally inoculated mice washed and resuspended in PBS, pH 7.4. Tachyzoites were incubated at 95°C for 10 minutes for protein denaturing and to release DNA.

Table 1: Primers used in nested PCR for detection of *Toxoplasma gondii*

Primer sequences		Target
External primer		
Forward	5'-GGC AAA CAA AAC GAA GTG-3'	GRA6 gene
Reverse	5'-CGA CTA CAA GAC ATA GAG TG-3'	
Internal primers		
Forward	5'-GTA GCG TGC TTG TTG GCG AC-3'	
Reverse	5'-TAC AAG ACA TAG AGT GCC CC-3'	

RFLP analysis: To characterize *T. gondii* genotypes in positive samples. PCR products were digested with *MseI* (Fast Digest[®] Tru 1I, USA) following manufacturer's protocol. Briefly, 10µl of PCR product was digested for 1h at 37°C with 1 U of *MseI*. Digested products were visualized on 2% agarose gels stained with ethidium bromide (0.5µg/µl) after UV trans-illumination. PCR amplified product of *T. gondii* RH strain (type I) was used as a control. Genotyping of *T. gondii* strain was determined according to the restriction pattern (Fazaeli *et al*, 2000).

Results

In present study, 63 of 226 pregnant women (27.9%) were seropositive for *Toxoplasma*-

Table 2: Genotype analysis by *GRA6*-nested PCR restriction fragment length polymorphism and clinical symptoms in *T. gondii* seropositive pregnant women

Pregnant women (8)	clinical symptoms	PCR-RFLP	<i>Toxoplasma</i> genotype
GI (5)	cachexia (2)	+	genotype-I
IgG, IgM (+)	fever (2)	+	genotype-I
	Lymphadenopathy(1)	+	genotype-I
GII (3)	fever (2)	+	genotype-I
IgG (+) only	no symptoms(1)	+	genotype-I

NA preparations from 8 seropositive pregnant women (13.3%) yielded products with expected size using nested PCR of coding region of *GRA6* (Tab. 2). Eight pregnant women samples (5 in GI & 3 in GII) belonged to *T. gondii* genotype I, none of positive samples belonged to type II or III (Fig. 1).

Discussion

In Arab countries, toxoplasmosis among women ranged from 22.5 to 37.4% in Saudi Arabia (Shoura *et al*, 1973; Abbas *et al*, 1986), 37.5% in Libya (Kassem and Morsy, 1991), 37% in Jordan (Morsy and Michael, 1980), 95.5% in Kuwait (Behbehani and Al-Karmi, 1980) and in Egypt, pregnant women 22.2% and non-pregnant ones 20% showed *T. gondii* antibodies (Saleh *et al*, 2014).

No doubt, genetic diversity of *T. gondii* is more complicated (Lehmann *et al*, 2006). However, *T. gondii* genotype data in humans is still limited. This could be explained by transient nature of *T. gondii* organism in the blood (Holliman, 2009). Identification of *T.*

ma-specific antibodies. Among 226 women, 30 (13.3%) were seropositive for *Toxoplasma*-specific IgG & IgM and 33 (14.6%) were seropositive for IgG with no IgM. Sixty women (30/each) were only included in study. The major pregnant women showed asymptomatic, 83.3% of GI (women seropositive for IgG & IgM) and 90% of GII (IgG seropositive) were asymptomatic. The asymptomatic women came to antenatal care for *Toxoplasma* screening during pregnancy.

Seven seropositive pregnant women complained clinical symptoms, fever and cachexia in two women, lymphadenopathy in 1 women of GI and fever in 2 women of GII (Tab. 2).

gondii genotype is essential in the congenital infection.

In present study, 8/60 seropositive pregnant women (13.3%) were positive by *GRA6*-nested PCR and evaluated by RFLP analysis of amplified *GRA6* products. All cases belonged to type I. This procedure is convenient and avoids the need for previous method of isolation in mice or cell culture (Switaj *et al*, 2006). The detection of type I agreed with AIDS patients and congenital toxoplasmosis (Lindstrom *et al*, 2006). Atypical genotypes were reported in immunocompromised patients with toxoplasmosis in sub-Saharan Africa (Ajzenberg *et al*, 2009). In Egypt, *GRA6*-nested PCR RFLP of *T. gondii* infected patients showed typical genotype I (Tolba *et al*, 2014). *T. gondii* genotype I alone or association with genotype II or III was reported in 13 infected patients by multilocus-nested PCR technique (Boughattas *et al*, 2010). Genotyping isolates showed limited genetic diversity of *T. gondii* in man and animal (Wang *et al*, 2013).

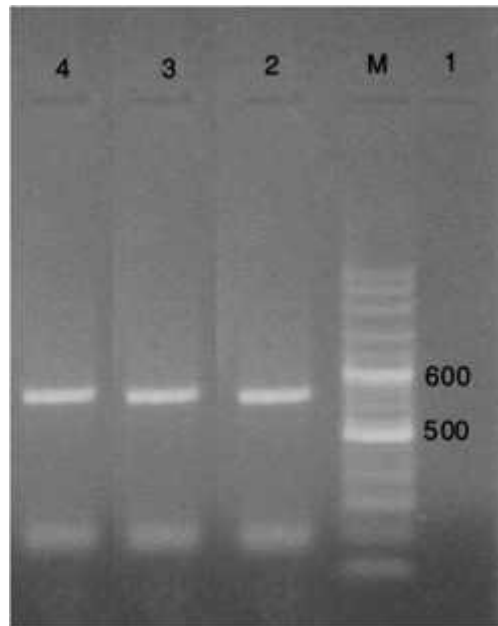


Fig.1: Restriction endonuclease digestion *GRA6*-nested PCR product of *T. gondii* with *MseI* from seropositive blood samples, negative control (Lane1), RH strain (Lane2). Genotype1 (Lane3 & 4), Size marker = a 100-bp ladder (lane M).

Genotypic of *T. gondii* isolates from rats were 59.1% of genotype II, 31.8% of genotype III and 9.1% were of an unknown genotype in Saudi Arabia. It means that the prevalence of *T. gondii* genotype II & III was high in rats (Elamin, 2014). The presence of type I in the present study agreed partly to study done in Al-Medina. In this study, genotypes I & III was in 20.9% and 21.9% respectively, while 45.1% of them belonged to type II. The 12.1% belonged to atypical genotypes (Abd El-Aal *et al*, 2010). In contrary, type II and atypical strains were reported in sandcats in Egypt and Qatar (Dubey *et al*, 2010). Type II & III strains were reported in Iranian infected animals (Fazaeli *et al*, 2000). In Egypt, *T. gondii* clonal types II & III were reported in chicken (Dubey *et al*, 2003). Atypical strains were found in 3.4 % of cat isolates (Al-Kappany *et al*, 2010). In human, genotype II was the most prevalent type detected in 33 (87%) infected female. Genotype I was found in 5(13%), but not genotype III (Abdel-Hameed and Hassanein, 2008). This discrepancy could be due to small number of positive cases, or difference in subjects and their life-style. The used cell culture or mice isolated parasite might produce sensitive variations in frequen-

cies of that effected different strains. Also, the various hosts could shelter different *T. gondii* genotypes (Elamin, 2014). In general, the deficiency of data on *Toxoplasma* genotyping in Saudi Arabia makes it hard to give an explanation.

Seven out of eight *T. gondii* nested PCR positive cases showed symptoms (87.5%). An elevated frequency of type I strains was also observed among immunocompromised patients with recurrent retinal toxoplasmosis and cerebral disease (Grigg *et al*, 2001; Vallochi *et al*, 2005; Switaj *et al*, 2006). The results could be explained by increased pathogenicity of type I strains (Grigg and Suzuki, 2003). Although no relationship was found between the presence of a specific strain type and the clinical presentation (Ferreira *et al*, 2008), *T. gondii* genotype I was major virulent type with high level of parasitemia (Howe and Sibley, 1995). But, data of genotypes responsible for the frequent asymptomatic toxoplasmosis is limited.

Conclusion

Serology and genotyping of *T. gondii* from pregnant women performed directly. *GRA6*-nested PCR RFLP proved to be fast & highly effective method and could be used directly on clinical specimens to obviate time

consuming procedures as culture. By *GRA6*-nested PCR RFLP blood samples revealed that *T. gondii* type I is predominant in Saudi Arabian women with different clinical symptoms. Toxoplasmosis & congenital toxoplasmosis is a worldwide problem. Health education is a must for child-bearing age women to minimize the complications.

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