


BRIEF REPORT

Contribution of the *Toxoplasma* ICT IgG IgM[®] test in determining the immune status of pregnant women against toxoplasmosis

Ben-Abdallah Rym^{1,2}  | Kalboussi Yasmine¹ | Bellali Hedia³ | Issaoui Nesrine¹ | Souissi Olfa¹ | Maatoug Rania¹ | Aoun Karim^{1,2} | Bouratbine Aïda^{1,2}

¹Department of Parasitology, Pasteur Institute of Tunis, Tunis, Tunisia

²Research Laboratory Medical Parasitology, Biotechnology and Biomolecul LR 11IPT-06, Pasteur Institute of Tunis, University Tunis El-Manar, Tunis, Tunisia

³Department of Epidemiology, Abderrahmane Mami Hospital, Ariana, Tunisia

Correspondence

Ben-Abdallah Rym, Department of Parasitology, Pasteur Institute of Tunis, 13 PI Pasteur, BP 74, 1002 Tunis, Tunisia.
Emails: ismail_rym@yahoo.fr

Abstract

Background: An immunochromatography technology (ICT) rapid diagnostic test, the *Toxoplasma* ICT IgG-IgM[®], was recently developed. Our aim was to study its contribution to establish accurately the *Toxoplasma* immune status in Tunisian pregnant women using Western blot (WB) Toxo II IgG[®] as a reference technique.

Methods: Thirty-nine sera were selected for the study from among 2,615 which were already tested by IgG and IgM ELISA. They displayed equivocal IgG titres (4.4–9 IU/ml) in absence of IgM (19 sera) or IgM anti-*Toxoplasma* antibodies in absence of IgG (titre <4.4 IU/ml) (20 sera). All these sera were additionally tested by WB Toxo II IgG[®].

Results: Immunochromatography technology Sensitivity in the detection either of low IgG titres in absence of IgM or of specific anti-*Toxoplasma* IgM was 100%. Only one serum with equivocal IgG titre by ELISA and negative with Toxo II IgG[®] test revealed positive in ICT. However, this serum showed a P30 band in WB analysis. On the other hand, three sera positive in ELISA IgM and negative in ELISA IgG revealed positive in ICT and negative in WB Toxo II IgG[®], the reference test.

Conclusion: Results confirm the high sensitivity of *Toxoplasma* ICT IgG-IgM[®] in detecting both specific anti-*Toxoplasma* IgG and IgM, and highlight the usefulness of this rapid test as a first or second-line *Toxoplasma* serological test in pregnant women.

KEYWORDS

pregnant women, *Toxoplasma* ICT IgG-IgM[®], toxoplasmosis, western blot Toxo II IgG[®]

1 | INTRODUCTION

In Tunisia, *Toxoplasma* infection prevalence is high (estimated at 58.4%), justifying the assessment of the *Toxoplasma* immune status in pregnant women.¹ The follow-up of obstetrical toxoplasmosis involves the systematic serological screening for *Toxoplasma*-specific IgG and IgM antibodies which is usually performed using ELISA techniques.¹ We may face three serological profiles that need specific

management: the absence of immunity, chronic infections and acute infections. In the following situations, however, screening tests used routinely are not sufficient and require additional techniques to determine the *Toxoplasma* immune status. These are (i) an equivocal IgG titre or (ii) the presence of IgM with the absence of IgG. In both contexts, the Immunoblot is considered the best method to identify specific anti-*Toxoplasma* IgG even present at a very low level.^{2–4} Nevertheless, Immunoblot kits on the market such as Toxo II

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

© 2021 The Authors. *Journal of Clinical Laboratory Analysis* published by Wiley Periodicals LLC

IgG[®] (LDBIO Diagnostics, France) remain expensive, and their use is limited to reference laboratories, mainly in developed countries. Recently, an immunochromatography technology-based (ICT) test, *Toxoplasma* ICT IgG-IgM[®] (LDBIO Diagnostics) was developed. This is a low-cost qualitative test detecting simultaneously specific anti-*Toxoplasma* IgG and IgM antibodies. According to several studies, *Toxoplasma* ICT IgG-IgM[®] has a high sensitivity for IgG detection, close to the Western blot (WB) technique sensitivity.⁵ Furthermore, this ICT test was able to distinguish between non-specific IgM and specific IgM; natural IgM being not identified.⁵ The aim of this study was to assess the contribution of the *Toxoplasma* ICT IgG-IgM[®] test in determining the *Toxoplasma* immune status of pregnant women in Tunisia.

2 | METHODS

2.1 | Samples

Thirty-nine anonymous sera available from the collection of the Parasitology Department of the Pasteur Institute of Tunis were included in this study. They were selected from among 2,615 sera collected during the period 2015–2018 in the setting of the routine *Toxoplasma* serological screening in pregnant women. Sera were selected according to their anti-*Toxoplasma* IgM and IgG antibodies titres in “Platelia Toxo IgG, IgM[®]” (Biorad, France). Western blot Toxo II IgG[®] was performed for all the sera in order to precisely determine their exact *Toxoplasma* immune status. WB Toxo II IgG[®] is routinely performed in our laboratory for sera that display (i) equivocal IgG titres (4.4–9 IU/ml) in absence of IgM⁴ or (ii) *Toxoplasma*-specific IgM without IgG (titre <4.4 IU/ml). In this latter case, WB Toxo II IgG[®] use aims to detect even a low IgG level early that always appears following *Toxoplasma*-specific IgM. In the absence of *Toxoplasma*-specific IgG during 2-month follow-up, detected IgM is considered non-specific.⁶

The 39 selected sera were grouped as follows:

- Group 1: 19 samples with IgG titres (4.4–9 IU/ml) and absence of IgM in ELISA corresponding to 17 positive and two negative samples in WB Toxo II IgG[®].
- Group 2: 20 samples with the presence of IgM and absence of IgG in ELISA corresponding to seven positive and 13 negative samples in WB Toxo II IgG[®] performed during the 2-month follow-up.

It is important to note that according to the manufacturer, a positive WB Toxo II IgG[®] is defined by the detection of at least three of the 30, 31, 33, 40 or 45 kDa bands.

2.2 | *Toxoplasma* ICT IgG-IgM[®]

Toxoplasma ICT IgG-IgM[®] (LDBIO, France) is a rapid, simple, qualitative test based on immunochromatography technology (lateral flow).

A positive test reveals the presence of anti-*Toxoplasma* antibodies but does not distinguish between IgG and IgM classes.

2.3 | Statistical analysis

All serological data were entered using Excel and analysed using IBM SPSS version 23.0 software. *Toxoplasma* ICT IgG-IgM[®] sensitivity was computed considering WB Toxo II IgG[®] as the reference test. The diagnostic performance of laboratory tests was evaluated using their sensitivity and specificity. Positive and negative predictive (PPV and NPV) values were calculated using Bayes' theorem.

3 | RESULTS

In the absence of IgM and presence of IgG equivocal titres in ELISA, *Toxoplasma* ICT IgG-IgM[®] and WB Toxo II[®] results were 94.7% (73.9–99.8) concordant. All positive samples in WB were also positive in ICT (Table 1). As a result, ICT sensitivity in detecting low levels of IgG antibodies was 100% (82.3–100.0) whereas specificity was 50% (28.8–75.5). PPV and NPV were, respectively, 100% (82.3–100) and 34% (16.3–61.6). However, the small number of samples did not allow an accurate specificity assessment. One of the two negative samples in WB Toxo II IgG[®] was positive in ICT (Table 1). This sample presented only two apparent bands at 30 kDa and 31 kDa in WB Toxo II IgG[®].

In the presence of IgM and absence of IgG in ELISA, results of *Toxoplasma* ICT IgG-IgM[®] and WB Toxo II[®] were 85% (62.1–96.8)

TABLE 1 Comparison of ICT *Toxoplasma* IgG-IgM and Western Blot Toxo II IgG results in detecting low titres of anti-*Toxoplasma* IgG

	Western blot Toxo II IgG		
	Positif	Négatif	Total
ICT <i>Toxoplasma</i> IgG-IgM			
Positif	17	1	18
Négatif	0	1	1
Total	17	2	19

TABLE 2 Comparison of ICT *Toxoplasma* IgG-IgM and Western Blot Toxo II IgG follow-up results in detecting specific anti-*Toxoplasma* IgG

	Western blot Toxo II IgG		
	Positif	Négatif	Total
ICT <i>Toxoplasma</i> IgG-IgM			
Positif	7	3	10
Négatif	0	10	10
Total	7	13	20

concordant. All positive samples in WB Toxo II[®] follow-up were also positive in ICT (Table 2). As a result, ICT sensitivity in detecting specific anti-*Toxoplasma* IgM was 100% (83.2–100.0). Of the 13 negative samples in WB Toxo II[®], three were positive by ICT which show specificity of 76.9% (46.2–94.9). PPV and NPV were respectively 100% (69.4–100.0) and 69.3% (44.9–92.21).

4 | DISCUSSION

As reported by other authors, the ICT test appeared to be as sensitive as the WB Toxo II IgG[®] method to confirm a low level of specific IgG antibodies in absence of IgM.^{5,7,8} This result was expected as the ICT test is calibrated with the Toxo II IgG[®] assay marketed by the same company. One false-IgG positive case was detected with an ICT test. It presented two bands by WB Toxo II IgG[®] including the P30 kDa. This result may suggest a higher sensitivity of the ICT test compared to that of the WB Toxo II IgG[®]. It also highlights the importance of the presence of the only anti-P30 antibodies in several cases. In fact, Jost *et al.* have demonstrated that the 30 kDa band tends to appear first during seroconversion based on the follow-up of pregnant women whose first serology was IgM positive and IgG negative or equivocal by routine methods.⁹ To elucidate this hypothesis, only the use of a sufficiently sensitive confirmatory technique such as the Dye test would lead to reliable conclusions.^{9,10}

The ICT test was also associated with 100% sensitivity in screening specific IgM. Such findings correspond to those of Mahinc's study that described the ICT test as a very useful tool for IgM without IgG detection.⁵ In addition, Mahinc *et al.* also supported the ability of ICT to distinguish non-specific from specific IgM.⁵ Three out of 13 sera (23.1%) with the presence of IgM and the absence of IgG during the 2-month follow-up were positive in ICT. Since ICT does not distinguish between IgG and IgM classes, positivity may suggest, as previously discussed, a higher sensitivity than Toxo II IgG[®] to detect IgG in an early sampling. However, the absence of IgG presence during follow-up may indicate false specific IgM detection.

Regarding its simplicity, low cost and high sensitivity in detecting specific anti-*Toxoplasma* IgG and IgM, the ICT test could be used as a first-line technique in the serological screening and could be recommended for the follow-up of seronegative pregnant women. Positive results, however, should be confirmed by other more specific reference techniques. On the other hand, ICT could also be useful as a second-line test following IgG and IgM ELISA to confirm low IgG titres and specific IgM. To our knowledge, our study is the first using this new technology to establish the *Toxoplasma* immune status of pregnant women in North Africa. The results obtained correspond to those of Mahinc *et al.* on a similar panel of sera. A survey using a larger group of samples would strengthen the conclusions and lead to new recommendations.

ACKNOWLEDGEMENTS

We thank Pr Imen Ben Abda for reviewing the manuscript and Dr Denis Limonne and the LDBIO DIAGNOSTIC's Society for providing us with the ICT tests used in this work.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

DATA AVAILABILITY STATEMENT

The authors confirm that the data supporting the findings of this study are available within the article.

ORCID

Ben-Abdallah Rym  <https://orcid.org/0000-0002-4282-1320>

REFERENCES

1. Bouratbine A, Siala E, Chahed MK, Aoun K, Ben Ismail R. Profil séro-épidémiologique de la toxoplasmose au nord de la Tunisie. *Parasite*. 2001;8(1):61-66.
2. Khammari I, Saghrouni F, Yaacoub A, et al. IgG western blot for confirmatory diagnosis of equivocal cases of toxoplasmosis by EIA-IgG and fluorescent antibody test. *Korean J Parasitol*. 2013;51(4):485-488.
3. Leslé F, Touafek F, Fekkar A, Mazier D, Paris L. Discrepancies between a new highly sensitive *Toxoplasma gondii* ELISA assay and other reagents: interest of Toxo IgG Western blot. *Eur J Clin Microbiol Infect Dis*. 2011;30(10):1207-1212.
4. Mouri O, Kendjo E, Touafek F, et al. The impact of lowering the cut-off value on the sensitivity of the Platelia Elisa IgG (Bio-Rad) test for toxoplasmosis diagnosis. *Parasite [Internet]*. 2015;22:22.
5. Mahinc C, Flori P, Delaunay E, et al. Evaluation of a new immunochromatography technology test (LDBio diagnostics) to detect toxoplasma IgG and IgM: comparison with the routine architect technique. *J Clin Microbiol*. 2017;55(12):3395-3404.
6. Boudaouara Y, Aoun K, Maatoug R, Souissi O, Bouratbine A, Abdallah RB. Congenital toxoplasmosis in Tunisia: prenatal and neonatal diagnosis and postnatal follow-up of 35 cases. *Am J Trop Med Hygiene*. 2018;98(6):1722-1726.
7. Begeman IJ, Lykins J, Zhou Y, et al. Point-of-care testing for *Toxoplasma gondii* IgG/IgM using Toxoplasma ICT IgG-IgM test with sera from the United States and implications for developing countries. *PLoS Negl Trop Dis*. 2017;11(6):e0005670.
8. Chapey E, Wallon M, Peyron F. Evaluation of the LDBIO point of care test for the combined detection of toxoplasmic IgG and IgM. *Clin Chim Acta*. 2017;464:200-201.
9. Franck J, Garin YJ-F, Dumon H. LDBio-Toxo II immunoglobulin G western blot confirmatory test for anti-toxoplasma antibody detection. *J Clin Microbiol*. 2008;46(7):2334-2338.
10. Reiter-Owona I, Petersen E, Joynson D, et al. The past and present role of the Sabin±Feldman dye test in the serodiagnosis of toxoplasmosis. *Bull World Health Organ*. 1999;7:929-935.

How to cite this article: Rym B-A, Yasmine K, Hedia B, et al. Contribution of the *Toxoplasma* ICT IgG IgM[®] test in determining the immune status of pregnant women against toxoplasmosis. *J Clin Lab Anal*. 2021;35:e23749. <https://doi.org/10.1002/jcla.23749>