

66144_Auto_Edited.doc

WORD COUNT

2616

TIME SUBMITTED

29-SEP-2021 06:32PM

PAPER ID

77170240

Name of Journal: *World Journal of Gastroenterology*

Manuscript NO: 66144

Manuscript Type: OPINION REVIEW

Serologic diagnosis of celiac disease: May it be suitable for adults?

Giuseppe Losurdo, Milena Di Leo, Edoardo Santamato, Monica Arena, Maria Rendina, Carmelo Luigiano, Enzo Ierardi, Alfredo Di Leo

Abstract

The diagnosis of coeliac disease (CD) in adult patients requires the simultaneous assessment of clinics, serology and typical histological picture of villous atrophy. However, several years ago European society of pediatric gastroenterology, hepatology and nutrition guidelines approved new criteria for the diagnosis in children: biopsy could be avoided when anti-transglutaminase antibodies (TGAs) value exceeded the cut-off of x 10 upper limit of normal (ULN) and anti-endomysium antibodies were positive, independently from value. This “no biopsy” approach is a decisive need for pediatric population, allowing to avoid stressful endoscopic procedures in children, if unnecessary. This approach relies on the correlation existing in children between TGA levels and assessment of mucosal atrophy according to Marsh’s classification. Several evidences have shown that patients with villous atrophy have markedly elevated TGA levels. Therefore, we aimed to perform a narrative review on the topic in adults. Despite some studies confirmed that a x 10 ULN threshold value has a very good diagnostic performance, several evidences in adults suggest that TGA cut off should be different from that of pediatric population for reaching a good correlation with histological picture. In conclusion, the heterogeneity of study reports as well as some conditions, that may hamper the serological diagnosis of CD (such as seronegative CD, non celiac villous atrophy), and are much more common in adults than in children, could represent a limitation for the “no biopsy” approach to CD outside pediatric age.

Key Words: Celiac disease; Villous atrophy; Serology; Biopsy; Anti-transglutaminase antibody

Losurdo G, Di Leo M, Santamato E, Arena M, Rendina M, Luigiano C, Ierardi E, Di Leo A. Serologic diagnosis of celiac disease: May it be suitable for adults? *World J Gastroenterol* 2021; In press

Core Tip: A no biopsy approach to celiac disease diagnosis, based only on anti-transglutaminase titer is a well-established strategy in children and an appealing matter of debate in adults. Indeed, the same strategy is recommended by pediatric guidelines, since it allows to avoid about one third of upper endoscopy procedures. In adults, literature on the topic is flourishing even if the topic is still under-investigated, results are heterogeneous and some conditions may be relevant limiting factors.

INTRODUCTION

² Celiac disease (CD) is the most common immune-mediated enteropathy. It affects subjects with a genetic predisposition based on the presence of a human leukocyte antigen (HLA) DQ2/DQ8 haplotype and polymorphisms of several other inflammatory genes. The same genes are frequently involved in several other autoimmune conditions, and this explains why a high rate of coeliac patients suffers from at least another immune-mediated disease^[1,2].

CD is the only autoimmune disease certainly triggered by an exogenous factor, *i.e.* the ingestion of gluten. Gluten is a complex of alcohol soluble proteins such as gliadins, avenins and secalins. These rich-in-proline and glutamine peptides are difficultly hydrolyzed by humans for the absence of an enzyme called prolyl-endopeptidase on the brush border of enterocytes^[3].

Global prevalence of CD is about 1%^[4]. However considerable differences exist among various countries. Additionally, it is more frequent in females (2:1-3:1), like other autoimmune diseases. Diagnosis may occur in every moment of life. In the past, CD was considered a disease of the childhood^[4], but nowadays the trend is changing because the 50% of new diagnoses affects people over 50 years old. The most important difference between pediatric and adult patients concerns symptoms at onset: in children the intestinal signs are more frequent, while in adults the extra-intestinal manifestations are more typical^[5].

Clinical manifestations may include both intestinal and extra-intestinal symptoms. Intestinal manifestations are diarrhea, dyspepsia, bloating, abdominal pain. Extraintestinal findings are weight loss, iron deficiency anemia, microcytic or megaloblastic anemia, osteopenia^[6].

Malabsorption is the consequence of the mucosal injury caused by humoral and cell-mediated autoimmunity. In fact, tissue transglutaminase 2 (TTG2), an intestinal enzyme, makes gluten peptides toxic by reactions of transamidation and deamidation^[7]. Plasma cells release IgA antibodies against both self-components of the

mucosal layer and deamidated gluten peptides. IgA pass into the bloodstream as antibodies anti-transglutaminase 2 (TGAs), anti-endomysium (EMAs) and anti-deamidated gliadin peptides (DGPs) and their detection is useful for the diagnosis of CD^[4,8].

On the other side, an immune response mediated by CD3+ T cells takes place. These CD3+ T lymphocytes are called intraepithelial lymphocytes (IELs). IELs infiltrate the mucosal layer thus damaging enterocytes. In CD, IELs are usually more than 25/100 enterocytes and lose their normal pattern of distribution in the villous area, which is called base-tip pattern and is characterized by a little amount of IELs located at the base of the villi. Conversely, in CD IELs are abnormally distributed in the whole surface of the villi^[9].

The number of IELs is one of the two main histological criteria used for assessment of mucosal damage according to marsh classification; the other one is the reduction of the villous-crypta ratio. In normal duodenum, the villous is 3-fold longer than Lieberkhun crypt depth; in CD, the flattening of villi causes an inversion of the normal ratio from 3:1 to 1:1 until to 1:3.

These histological findings are assessed on biopsy samples taken from the duodenum. At least two samples from the bulb and four from the second part of duodenum should be taken in order to obtain an adequate sample^[10,11].

DIAGNOSIS

Currently, a combination of clinics, serology and histology is required to diagnose CD in adults.

A patient with suggestive intestinal or extraintestinal symptoms/signs should undergo a serological analysis to assess the IgAs levels: TGA IgAs are the most sensitive and specific antibodies for CD even if they do not allow to diagnose CD alone. The TGA test is performed by enzyme-linked immunosorbent assay. It is reliable and inexpensive, and represents the most sensitive test for CD (98%), with very low percentage of false positive when the titer is more than 5 -fold the upper limit of normal

value^[12]. The hypothesis of CD should be confirmed by EMAs positivity. Indeed, EMA is the most specific test (near to 100%) but the test is immunofluorescence-based, so it is operator dependent for its difficult interpretation^[13].

In patients with an IgA deficiency (a frequent condition in celiac patients), IgG levels should be assessed^[3]. A summary of diagnostic performance of serologic tests in CD is reported in Table 1^[14].

DPGs are not very useful in diagnosis, except if the patient is less than 2 years old; they could be considered in the follow-up, because their variations are very rapid after the starting of gluten free diet (GFD)^[15,16].

In adult population, endoscopy with duodenal biopsy samples is considered the gold standard for CD diagnosis. Several endoscopic findings may suggest CD with high sensitivity and specificity. However, more than the 33% of CD patients have normal endoscopic appearance, so biopsy samples should be collected in all patients with suspected CD irrespectively from endoscopic appearance. During upper GI endoscopy, at least 4-6 specimens should be collected including samples from duodenal bulb in order to increase the diagnostic yield^[17]. In each pass of biopsy forceps, the endoscopist should take only a single biopsy specimen^[18]. However, at least the 10% of specimens may not have an acceptable quality, due to insufficient size or lack of orientation and, sometimes, endoscopy should be repeated. Moreover, endoscopy is an invasive procedure with risk of complication, expensive, and the sedation is often required due to the duration of the procedure.

A level 3 in Marsh assessment corresponds to a complete villous atrophy and is required to diagnose CD.

However, ⁴European society of pediatric gastroenterology, hepatology and nutrition (ESPGHAN) guidelines in these last years stated that a different diagnostic algorithm could be used for children.

Then, guidelines stated that, if clinical features are present, TGA level overcomes the threshold of 10 UNL and EMAs are positive, histology and genetics could not be

carried out. This conclusion relies on the strong association between TGAs and Marsh's grade of atrophy^[19].

This approach, despite not applicable to all children, has changed the clinical practice since, at least in children, upper endoscopy is not easily performed. It has been estimated that the cited cut-off may avoid endoscopy in the 18% of celiac children, with a sensitivity of 96.3 and a specificity of 98.6%^[20]. In another study, the 29% of children could have avoided biopsy as per 2020 ESPGHAN guidelines, and levels of TGA \geq 60 U/mL or DGP \geq 28 U/mL had a 100% specificity and 100% positive predictive value (PPV) for CD. HLA typing and EMA did not improve the PPV of patients with a TGA \geq 60 U/mL, but addition of DGP \geq 28 U/mL improved diagnostic sensitivity albeit maintaining the 100% of specificity^[21].

The promising data found in pediatric literature have, therefore, pushed researcher to investigate whether a pure serologic approach could be used in adults with suspicion of CD. Therefore, we aimed to perform a narrative review on the topic in adults.

A NO-BIOPSY, SEROLOGY-BASED APPROACH IN ADULTS: CURRENT EVIDENCES

Several studies supported the “no-biopsy strategy” in adult population. Sugai *et al*^[22], in a prospective study evaluated the diagnostic accuracy of duodenal biopsy and serology for CD diagnosis (TGA and DGP), in two cohorts of subjects with different pre-test probabilities. In high-risk group (161 enrolled patients), the prevalence of CD was 39.1%, while in low-risk group (518 enrolled patients) the CD prevalence was 3.3%. Using assay combinations, it would be possible to confirm or rule out diagnosis of CD without biopsy in 92% of cases in both pre-test populations. Salmi *et al*^[23] compared histological examination to serum and intestinal celiac autoantibodies in untreated CD. They corroborated the high sensitivity and specificity of autoantibodies-TGA for detection of CD with villous atrophy. In 2008, Hill *et al*^[24] found that IgA TGA x 10 ULN could be used as diagnostic cut-off with a positive predictive value for CD of 100% in adults. Similar cut-off of TGA antibody level (x 10) was suggested by Beltran *et al*^[25] for

CD diagnosis, with a 100% specificity. However, the authors emphasized the necessity of local validation for cut-off value. The study of Penny *et al*^[26] confirmed IgA TGA title of x 10 ULN had 100% specificity as cut-off value for detect Marsh 3 lesions.

Other cut-off values of antibody TGA levels were found. In a retrospective study, Holmes *et al*^[27] enrolled 270 adults CD with IgA-TGA levels measure and small bowel biopsy samples. Authors found a cut-off greater than 45 U/mL (> x 8 upper limit of normal + 2SDs) had a PPV for CD of 100%. The same value was found by Tortora *et al*^[28]. In this study, the cut-off value of TGA of 45 U/mL had a sensitivity of the 70% and a specificity of the 100% for predicting Marsh ≥ 2 . Moreover, authors found that the best cut-off for predicting villous atrophy was 62.4 U/mL (sensitivity 69%, specificity 100%). A lower cut-off value of tissue-transglutaminase antibody was found in the retrospective study of Zanini *et al*^[29]: authors demonstrated a 100% specificity for duodenal atrophy with a cut-off value of tissue-transglutaminase antibody five times higher than the upper limit of normal. The application of this diagnostic approach, could avoid upper GI endoscopy in 1 out of 3 patients. In a multicenter retrospective analysis enrolling both pediatric and adult patients who underwent small-bowel biopsy for suspicion of CD and positivity to both TGA and EMA, Alessio *et al*^[30] demonstrated that TGA $\geq x 7$ ULN was able to diagnose CD with a specificity and PPV close to 100%. On the other hand, Di Tola *et al*^[31] determined that the best TGA serum levels/cut-off ratio was > 3.6 with a sensitivity of 76.8 % and PPV of 97.2 %. The use of threshold value for CD diagnosis, could avoid endoscopy with biopsy in the 75% of patients. Authors also found a strong correlation between TGA serum levels/cut-off ratio and the degree of duodenal lesions.

The combination of serology for IgA-TGA and IgA-EMA for CD diagnosis was retrospectively evaluated by Wakim-Fleming *et al*^[32]. In their cohort, a value of serum IgA TGA greater than 118 U had only 2% of false-positive rate. While, if the value of serum IgA TGA was between 21 and 118, the value of EMA at least 1:60 had a positive predictive value of 83% for CD. IgA-TGA levels less than 20 U, in combination with an EMA dilution titer less than 1:10, had a negative predictive value of 92% for CD.

Oyaert *et al*^[33] evaluated the use of IgA TGA value associated with IgG-DGP antibody for CD diagnosis, in pediatric and adult population. Patients with double positivity and high antibody levels (> 3 times, > 10 times ULN) had a high probability for having CD (likelihood ratio ≥ 649 for > 3 times ULN and ∞ for > 10 times ULN). However, the sensitivity was significantly higher for all test combinations in the group aged younger than 16 years compared to adult group.

The study by Efthymakis *et al*^[34] found the optimal cut-off anti-TGA value was $\geq x$ 16 ULN. In this study, eleven different assays were used for TGA titer determination. Analyzing the two more prevalent, authors found different optimal cut-off values (14.3 \times ULN vs 3.7 \times ULN), even after standardization (-0.14 vs -1.2).

SEROLOGY AND PERSISTENT ATROPHY IN THE FOLLOW UP

Key endpoints at follow-up of CD patients are the absence of symptoms and the achievement of mucosal healing, *i.e.* regression of atrophy. After 6-12 mo of adhering to a GFD, serology becomes negative in the 80% of patients and in the 90% after 5 years.

Unfortunately, a normal TGA level at follow up does not predict recovery of villous atrophy. Really, the lack of declining values and/or persistently positive serology one year after starting a GFD strongly suggest gluten contamination. Indeed, a recent meta-analysis demonstrated that IgA-TGA and IgA-EMA detected persistent villous atrophy with high specificity (83%) but low sensitivity (50%).

Of interest, this study emphasized a presumable different CD diagnostic tool pattern between pediatric and adult age. Indeed, the area under the curve for villous atrophy prediction was higher for children than for adults (0.879 vs 0.781)^[16].

CONCLUSION

Biopsy-free strategy is a promising approach for the diagnosis of CD in subgroups of adult population, with sensitivity and specificity close to 100%. However, it should be highlighted that in adults the diagnosis of CD may be more challenging than in children, since villous atrophy and increased IELs might be related not only to CD, but

even to other pathologic conditions, including drug damage, infections or functional gastrointestinal disorders^[35-41].

On the other hand, seronegative CD is a rare condition that may be found in adults. It should be always kept into account when clinical symptoms are highly suggestive of the disorder despite the absence of serological markers and, in this case, histological examination is the mandatory diagnostic tool^[42,43].

Moreover, the possibility of false positivity of TGA has been described, especially after viral respiratory infections^[44].

In conclusion, despite the results show that biopsy-free strategy may be promising in adults, some cautions should be taken into account before performing a fully serologic diagnosis of CD. Indeed, the topic is still under-investigated, the results of the studies are heterogeneous and some conditions, such as seronegative CD or intestinal damage due to causes other than gluten, may be relevant limiting factors. Furthermore, since most of studies are retrospective, the real possibility of avoiding endoscopic examination for diagnosing CD in adults is still a matter of debate and requires further research. Therefore, further studies with a standardized approach are still required to evaluate this strategy and determine the best cut-off.

10%

SIMILARITY INDEX

PRIMARY SOURCES

- 1 Grace Thompson, Zubin Grover, Richard Loh, Catherine Mews et al. "Assessment of European Society of Paediatric Gastroenterology Hepatology and Nutrition (ESPGHAN) guidelines in an Australian paediatric population", Pathology, 2020
55 words — 2%
Crossref
 - 2 docplayer.net
Internet
45 words — 2%
 - 3 www.degruyter.com
Internet
44 words — 2%
 - 4 link.springer.com
Internet
32 words — 1%
 - 5 Konstantinos Efthymakis, Mariaelena Serio, Angelo Milano, Francesco Laterza et al. "Application of the Biopsy-Sparing ESPGHAN Guidelines for Celiac Disease Diagnosis in Adults: A Real-Life Study", Digestive Diseases and Sciences, 2017
26 words — 1%
Crossref
 - 6 www.ncbi.nlm.nih.gov
Internet
19 words — 1%
 - 7 worldwidescience.org
Internet
17 words — 1%
-

8 Zanini, B.. "High tissue-transglutaminase antibody level predicts small intestinal villous atrophy in adult patients at high risk of celiac disease", Digestive and Liver Disease, 201204 16 words — 1%

Crossref

9 Abdulbaqi Al-Toma, Umberto Volta, Renata Auricchio, Gemma Castillejo et al. "European Society for the Study of Coeliac Disease (ESsCD) guideline for coeliac disease and other gluten-related disorders", United European Gastroenterology Journal, 2019 15 words — 1%

Crossref

EXCLUDE QUOTES ON

EXCLUDE MATCHES < 1%

EXCLUDE BIBLIOGRAPHY ON