Biochemical markers in celiac disease

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1. ABSTRACT

Celiac Disease is a worldwide spread condition affecting 1:100-1:200 individuals. It is a permanent food intolerance to ingested gluten in genetically predisposed subjects. In this review we analyze the biochemical markers of the disease going from laboratory findings to histology passing through genetics. Gluten intolerance is a unique model of autoimmune disease in which we can recognize the main environmental factor (gluten) and the more complex genetic background. In additional way, serological markers for monitoring the disease and a safe and effective therapy (gluten free diet) are also available. In deed the environmental factor such as gluten intake is necessary to trigger the disease but genetics also matter. HLA genes are the most studied but in recent times also not HLA related genes are giving proof of additional relative risk to disease if present. From histological point of view intra epithelial cell infiltration by several lymphocyte subsets is becoming more and more important also for understanding pathogenesis of the disease.

2. INTRODUCTION

Celiac Disease (CD) is a permanent gluten triggered enteropathy in genetically susceptible individuals. Diagnosis of disease may be simple in overt classical forms, more challenging and difficult in atypical ones. Up to date several tools concur to perform a combined diagnosis. In deed clinicians have serological, genetic and histological means that embedded to clinical features may be helpful to diagnose CD. From a biochemical point of view each of the above mentioned diagnostic items has biological and chemical markers.

3. CLINICAL BIOCHEMISTRY

The total blood cell count may evidence increased number of platelets at onset of disease. Thrombocytosis is generally light to moderate with values ranging between 450,000 and 650,000. This finding is absolutely independent from the more well known and more well recognized iron deficiency anaemia (1). Iron deficiency
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anaemia in active celiac disease is sustained by damage of distal duodenum with consecutive impaired iron absorption. For this reason this kind of anaemia is refractory to oral iron supplementation. Iron deposits may be reduced. Total iron binding capacity is increased.

4. SEROLOGY

Serology changed the diagnostic criteria for celiac disease after 1991 (2). The first antibodies detected in the serum of celiac patients were AGA, id est Anti-Gliadin Antibodies. They were used from 1983 and performed with ELISA method. They belong to IgA or IgG class of circulating immunoglobulins. Up to date they are almost completely replaced by anti human tissue trans-glutaminase antibodies (hTTG). Only in Pediatrics, in the younger children lesser than two years of age, AGA maintain a good sensibility and specificity in spite of the more recent ones anti hTTG.

Recent studies evaluated a new generation class of Anti Gliadin Antibodies against deamidated gliadin peptide (dgp) in monitoring children on gluten free diet (GFD). Their serological increase may precede than of anti hTTG if gluten is ingested (3). Anti Endomysium Antibodies (AEA) were introduced in the early 90’s. They are performed by ELISA or, in the most of cases, by Indirect Immuno-Fluorescence (IF) method. They have both sensitivity and specificity higher than 95% and near to 100%. First generation of AEA used monkey esophagus as biological substrate, while the modern ones use Human Umbilical cord. This kind of method strongly depends on performer experience if executed by IIF. ELISA is more reliable and reproducible. All the two possible methods give equivalent results provided that IIF AEA were correctly understood. The best and the more recent serological marker for detecting and monitoring CD is the assay of anti tissue transglutaminase antibodies. Discovered in 1997 by Dieterich and coll. (4), its use was largely widespread in all screening practices. Human transglutaminase is an ubiquitous enzyme which catalyses the cross linking transamination from a NH₂ containing donor peptide to an acceptor one. Antibodies to TTG are produced by B lymphocytes of the intestinal intra-epithelial lymphocyte activation (24-26). Another significant genetic locus is IL-2 and IL-21 genes, cytokines involved in T-cell clonal anergy (19-21).

The mapping of genome shows a strong association of CELIAC 5 on chromosome 15q11-q13 (CELIAC 5) and celiac disease (23). The mapping of genome shows a strong association of the 4q27 (CELIAC 6) region with CD. This region contains IL-2 and IL-21 genes, cytokines involved in T-cell activation (24-26). Another significant genetic locus is located on the 1q31 region (CELIAC 7) encoding RGS1 (regulator of G-protein signalling 1), which is widely expressed in the intestinal intra-epithelial lymphocyte compartment (26-28). The Linkage Disequilibrium block contains two genes mapped on 2q11-2q12 (CELIAC 8) which are receptors for the IL-18 protein involved in the gamma-interferon synthesis by T-cell (26, 29). Mature IL-18 is expressed in the intestinal mucosa of active, treated and latent celiac patients but not in healthy ones. CELIAC 9 gene (3p21) encodes several chemokines which are critical for cellular recruitment and inflammation pathway. The 3q25-3q26 region (CELIAC 10) encodes the
IL-12, that has an important role in T-helper response. Relatively little is known about CELIAC 11 (3q28) and CELIAC 12 (6q25) and about their immunological role. SH2B3 (lymphocyte adaptor protein), encoded by 12q24 (CELIAC 13), is strongly expressed in the small bowel and involved in leukocyte recruitment and activation (26). CD, type 1 diabetes and rheumatoid arthritis sharing several genetic factors regulating innate and adaptive immunity are probably also able to trigger immunological activation against environmental factors.

6. HISTOLOGY

Histological damage in CD consists of three different periods. The infiltration phase characterized by intra-epithelial lymphocytes infiltration, the hyperplastic phase with decrease of villous/crypt ratio and the destructive one consisting of villous atrophy and mucosal flattening. Up to date definitive diagnosis of CD rests upon histological findings of increased intra-epithelial lymphocytes of the small bowel associated or not to decrease of villous height-crypt depth (Vh/CrD) ratio. Crypt hyperplasia is the result of over expressed bowel cellular mitosis (30). Indeed immature enterocytes make an attempt to replace mature ones destroyed by immunological process. Immature epitheliocytes are lacking of lactase giving proof of secondary lactase deficiency typical of CD.

CD related histological lesions are present in the duodenal mucosa, but sometimes the bulb is the only site affected. The immunological process in CD is mediate by cytokines unbalance between pro-inflammatory chemokines (IFN-gamma, TNF-alpha, IL-12, IL-15) and anti-inflammatory ones (IL-10 and TGF-beta) (31). The IL-15, produced by enterocytes, promotes autoimmunity by arming cytotoxic T-lymphocytes to cause tissue destruction in CD. Intraepithelial T-lymphocytes CD8+ interplay with enterocytes by MHC I interaction (32). In fact epithelial cells behave like APC, presenting gliadin peptides to CD8+ enterocytes by MHC I interaction (32). In fact epithelial cells behave like APC, presenting gliadin peptides to CD8+ enterocytes by MHC I interaction (32). In fact epithelial cells behave like APC, presenting gliadin peptides to CD8+ enterocytes by MHC I interaction (32).

8. REFERENCES


7. CONCLUSIONS

CD is a complex and multi-factorial disease in which environmental factors and genetic susceptibility are embedded. Several biochemical markers are available to detect CD and some of them (anti-TTG, AEA, AGA) are also useful to follow-up the disease. In the last years incidence of CD was world-wide increased: latest studies report incidence 1:100 in open population. HLA molecule know as DQ2 is very frequent in normal population, probably for evolutionary reasons. Indeed HLA susceptibility genes conferred in ancient times or in pre-antibiotic era a sort of protection against infectious diseases. This was responsible of positive selection of HLA-DQ2 carriers versus DQ2 negative subjects which were negatively selected by intractable infectious diarrhea. DQ2 carriers affected by mild enteropathy on a diet regimen based on foodstuffs derived by early grains containing small amount of gluten were protected by infectious enteritis. Nowadays DQ2 carriers have a rich gluten containing diet due to the fact that modern cultivars of grains are esaploid and wheaten flour contains up to 50% of gluten derived proteins. With the defeat of infectious diseases the positive selected DQ2 carriers have an increased probability of become gluten-intolerants. In this context non-HLA genes increase the relative risk of CD in gluten eating people.


27. Han SB, et al: Rgs1 and Gna12 regulate the entrance of B lymphocytes into lymph nodes and B cell motility within lymph node follicles. *Immunity* 22, 343–54 (2005)
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35. Ebert EC: IL-15 converts human intestinal intraepithelial lymphocytes to CD94 producers of IFN-gamma and IL-10, the latter promoting Fas ligand-mediated cytotoxicity. *Immunology* 115(1), 118-26 (2005)


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