

Dear Editor,

Thank you very much for your request to submit an in invited manuscript prior to June 28, 2015. It is with great pleasure that we submit this important and timely review article to WJGPT. The topic is: HCV: A Time for Decisions; Who to Treat and either Treat Now or Wait?

Detection of chronic HCV infection and the current effective treatment has been shown to achieve a cure of HCV manifested mostly by reaching a sustained virological response (SVR). Such a successful treatment is associated with a lower all-cause mortality rate and obviously a substantial reduction in overall direct and indirect costs of healthcare. The accumulated cost over years includes: the clinical management of chronic hepatitis, cirrhosis, hepatocellular cancer (HCC), liver transplantations as well as extrahepatic manifestations.

Our review of this crucial and very important aspect of hepatitis C management outcome is a major issue that affect many physicians today. This topic is of essential importance and interest to all physicians and we consider your Journal the most appropriate for this article.

We will be glad to modify this publication to abide by all the rules of publication if you are interested in this topic pending an appropriate review. We are highly appreciative of your efforts in reviewing our manuscript.

PS: the invitation to submit an invited manuscript is for Dr. David Van Thiel

**Bashar M. Attar, M.D., Ph.D., M.P.H.(epid)**

FACP, FACC, AGAF, FASGE  
System Chair, Division of Gastroenterology and Hepatology  
Cook County Health and Hospitals System  
Director, GI Fellowship Program  
John H. Stroger Hospital of Cook County  
Professor of Medicine  
Rush University Medical Center  
[battar@post.harvard.edu](mailto:battar@post.harvard.edu)

1901 West Harrison Street  
Chicago, IL 60612  
Office (312) 864-7213  
Office (312) 864-7230 (direct)  
Pager (312) 689-1188  
Cell (312)282-6521

**Co-author:**

**David Van Thiel, M.D.**

Advanced Liver and Gastrointestinal Disease Center  
Berwyn, IL 60402

# **HCV: A Time for Decisions Who to Treat and either Treat Now or Wait?**

**Authors: Bashar M. Attar and David Van Thiel**

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**Corresponding Author:**

**Bashar M. Attar, M.D., Ph.D., M.P.H.(epid), M.H.C.M.**

FACP, FACP, AGAF, FASGE, AGSF, FAASLD

System Chair, Division of Gastroenterology and Hepatology

Cook County Health and Hospitals System

Director, GI Fellowship Program

John H. Stroger Hospital of Cook County

Professor of Medicine

Rush University Medical Center

Address:

**1901 West Harrison Street**

**Admin Bldg; Suite 1450**

**Chicago, IL 60612**

Office (312) 864-7213

Office (312) 864-7230 (direct)

Pager (312) 689-1188

Cell (312) 282-6521

e-mail: [battar@rush.edu](mailto:battar@rush.edu)

**Disclosures: No relevant disclosures**

**David Van Thiel, M.D.**

Advanced Liver and Gastrointestinal Disease Center

Berwyn, IL 60402

Email: [dvanthiel@dr.com](mailto:dvanthiel@dr.com)

**Disclosures: No relevant disclosures**

## **Author Biography**

**Bashar M. Attar, M.D., Ph.D.**, is the System-wide Chairman for Gastroenterology /Hepatology at Cook County Health and Hospitals System. Dr. Attar is certified by the American Board of Internal Medicine, Gastroenterology, Geriatric Medicine, and Transplant Hepatology. He received his education at BU, Harvard, U Illinois, and Northwestern U. He has special interest in viral hepatitis. Dr. Attar holds an M.P.H. in Epidemiology and a M.Sc. in Health Care Management from the Harvard School of Public Health/ Harvard Medical school. Dr. Attar is the past President of the Chicago Society for Gastroenterology. He is a strong supporter of viral hepatitis screening and prevention strategies that are advocated by the American Association of the Study of Liver Diseases (AASLD).

**David H. Van Thiel, M.D.** has been practicing medicine for 47 years. He is a specialist in Gastroenterology and Hepatology. Dr. Van Thiel graduated from the University of California, Los Angeles David Geffen School of Medicine in 1967. He is the Director of Advanced Liver and Gastrointestinal Disease Center in Berwyn, IL. Dr. Van Thiel is affiliated with Rush Oak Park Hospital and Rush University Medical Center. Dr. Van Thiel is past Medical Director of Liver Transplant Center at the University of Pittsburgh during the Thomas Starzl, MD (father of surgical liver transplantation) era.

## **I. Abstract**

**Context:** Cirrhosis is the most important risk factor for hepatocellular cancer (HCC) regardless of the etiology of cirrhosis. Compared to individuals who are anti-HCV seronegative, anti-HCV seropositive individuals have a greater mortality from both hepatic as well as nonhepatic disease processes.

**Objective:** To describe the burden of HCV infection and consider treatment strategies to reduce HCV-related morbidity and mortality. The newly developed direct acting antiviral (DAA) therapies are associated with greater rates of drug compliance, fewer adverse effects, and appear not to be limited by the presence of a variety of factors that adversely affect the outcome of interferon-based therapies.

**Outcome:** Because of the cost of the recently developed direct acting antivirals, their use has been severely rationed by insurers as well as state and federal agencies to those with advanced fibrotic liver disease. The rationale for such rationing is that many of those recognized as having the disease progress slowly over many years and will not develop advanced liver disease manifested as chronic hepatitis C, cirrhosis, and experience any of the multiple complications of liver disease to include hepatocellular carcinoma (HCC).

This reasoning consisting of a short sided view of the cost of treatment of hepatitis C related disease processes and ignores the long-term costs of hepatitis C treatment consisting of the cost of treatment of hepatitis C, the cost of treatment of cirrhosis, the cost of treatment of decompensated cirrhosis as well as the cost of treatment of HCC and liver transplantation.

**Conclusion:** We believe that a combination of increased treatment efficacy and a greater utilization of treatment to include all stages of the HCV liver disease as well as those who manifest extrahepatic manifestations of HCV infection should result in major reductions in the lifetime costs of HCV related disease regardless of its clinical presentation.

## **II. Introduction**

Chronic hepatitis C virus (HCV) infection is an important cause of advanced liver disease and liver-related deaths. The aim of this document is to describe the burden of HCV infection and consider treatment strategies to reduce HCV-related morbidity and mortality.<sup>1-5</sup>

It is estimated that the incidence of hepatocellular carcinoma (HCC) in Europe and United States will peak at 2020 at which there will be 78,000 new HCC cases in Europe and 27,000 in the United States.<sup>6</sup> Cirrhosis is the most important risk factor for HCC regardless of the etiology and cirrhosis occurs in the background of 90% of cases of HCC.<sup>6</sup>

These figures probably under estimate the actual prevalence of the disease HCV as they are based upon data that excludes groups at recognized highest risks for the infection. Despite these limitations relative to the current estimates of the disease prevalence, it is well recognized that 50-85% of the patients infected with HCV and manifest a hepatic disease process develop a chronic hepatitis and 20-25% of these cases progress to cirrhosis with 20% of this latter group progressing further to hepatocellular carcinoma.<sup>7-9</sup>

## **III. Risk of HCV Infection and Need for Screening**

HCV infection has an increasing HCV-related mortality from 1.09 to 2.40 per 100,000 person-years in the United States from 1995 to 2004.<sup>10</sup> The predicted mortality of HCV related disease over a 20- year period is expected to continue to rise as more and more individuals, who are currently infected, will have their disease for many more years. As a result, the healthcare

burden in direct and indirect costs related to HCV infection will continue to rise in the foreseeable future.<sup>10</sup> The detection of HCV RNA in serum identifies active cases manifested by replication of the virus. Lee et al reported that 52–80% of serum samples seropositive for anti-HCV have been reported to have detectable serum levels of HCV RNA.<sup>10</sup> Importantly, anti-HCV seropositive individuals with detectable serum HCV RNA have an increased risk of dying from all causes, whereas the risk for anti-HCV seropositives with negative HCV RNA is similar to that of HCV seronegative individuals.<sup>9,10</sup> Indeed, 2394 deaths occurred in HCV positive individuals during an average follow-up period of 16.2 years.<sup>10</sup> Compared to individuals, who are anti-HCV seronegative, anti-HCV seropositive individuals have a greater mortality from both hepatic as well as nonhepatic disease processes. The multivariate-adjusted hazard ratio (95% confidence interval) of 1.89 (1.66–2.15) for all causes of death in HCV seropositive individuals and 12.48 (9.34–16.66) for hepatic diseases, 1.35 (1.15–1.57) for extrahepatic diseases, 1.50 (1.10–2.03) for circulatory diseases, 2.77 (1.49–5.15) for nephritis, nephrotic syndrome, and nephrosis, 4.08 (1.38–12.08) for esophageal cancer, 8.22 (1.36–49.66) for thyroid cancer, and 4.19 (1.18–14.94) for prostate cancer.<sup>10</sup> Thus, the presence of HCV seropositivity increases the risk of death from a wide array of extrahepatic disease processes. Moreover, anti-HCV seropositives with detectable HCV RNA levels have a significantly greater mortality risk for death due to both hepatic and extrahepatic diseases processes than do individuals who are anti-HCV seropositives but who are HCV RNA negative. These data imply that individuals with chronic hepatitis C having an active infection manifested by HCV-RNA positivity should benefit from antiviral treatment to reduce both their overall mortality as well as hepatic disease mortality risk.<sup>10</sup>

Recently the Center for Disease Control (CDC) has identified individuals born between 1945 and 1965 as well as veterans, males, people in low income groups, prisoners, those in various institutions, and African American as well as the Latino populations as being at higher risk for a HCV infection.<sup>11</sup> As the majority of infected individuals have little or no symptoms, they may never know that they are infected despite the fact that 75-80% of them may develop a lifelong chronic infection that adversely affects their life quality as well as their longevity. Individuals in this latter group also include those who received plasma or blood transfusions prior to 1992, hemophiliacs, individuals on hemodialysis, organ transplant recipients, those who experience needle sticks as a result of illicit drug use or an occupational exposures and possibly those infected as a result of tattoos or the use of unsterile equipment for body piercing, children born of a hepatitis C positive mothers and those who practice unprotected or high risk sex with multiple partners (Table I). Most importantly, these asymptomatic individuals can unknowingly transmit the disease to others, thereby perpetuating the disease process in society at large.<sup>11,12</sup>

#### **IV. Therapy and Eradication of HCV**

Historically, the available therapeutic agents utilized for the treatment of chronic hepatitis C (interferon based therapies) have had only limited success at the elimination of the disease with efficacy rates ranging between 20 and 40% manifested as a sustained viral response (SVR) 6 months after a presumed end of treatment (EOT) course of therapy.<sup>12</sup> In addition, these historical treatment regimens were expensive in terms of their direct and indirect costs, albeit less so than the new direct acting antiviral agents and had numerous adverse effects that limited their acceptability by individuals, who would have been considered as appropriate candidates for therapy. Moreover, the use of interferon (IFN) based therapies is contraindicated in individuals



with a variety of autoimmune disease processes, those with a clinically significant depressive disorders, and those with advanced coronary artery or cerebrovascular disease. In addition, interferon based therapies have limited efficacy in individuals with different viral genotypes as well as specific genetic as well as phenotypic characteristics that include variant IL28B polymorphisms, obesity, diabetes mellitus, ethnicity and coinfection with either HBV or HIV.<sup>13,14</sup>

In contrast, the newly developed direct acting (DNA) antiviral therapies are administered orally and require less complex regimes. As a result, they are more readily acceptable. As a consequence of their enhanced acceptability and increased rate of drug compliance, they achieve a significantly greater efficacy rate, have fewer adverse effects and appear not to be limited by the presence of a variety of concurrent medical disease processes to include the aforementioned genetic and phenotypic characteristics that adversely affect the outcome of interferon-based therapies. It is expected that the newer 3<sup>rd</sup> generation DAAs soon to be approved by the FDA are even more efficacious and are effective across all genotypes as compared to the current 2<sup>nd</sup> generation DAA agents (Table II).<sup>15,16</sup>

By increasing the SVR to 90% or more from 2016 onward the number of treated cases in Belgium has been estimated to increase from 710 to 2,050 in 2030 resulting in a reduction of the number of cases with cirrhosis, decompensated cirrhosis and HCC disease process which have high direct and indirect costs of care.<sup>17</sup> The new DAAs are reported to be most efficacious as compared to historical regimens with interferon when applied to F2-F4 cases. To obtain comparable outcomes with all cases ranging from those with F0-F4

fibrosis, 50% more cases would have to be treated, a number which would appear to be achievable with the greater acceptability and reduced frequency of adverse events associated with the newer agents. Additionally, a two-year delay in access to the DAAs has been estimated to increase HCV related morbidity and mortality by 15%.<sup>17</sup>

These data suggest that early rather than later therapy of HCV infected individuals would be even more efficacious than waiting particularly if it includes all cases from F0-F4 hepatic disease.

Vander Meer et al<sup>18</sup>, have shown in an international, multicenter, long-term follow-up study from 5 large tertiary care hospitals in Canada and Europe consisting of 530 patients with chronic HCV infection, who started an interferon-based treatment regimen between 1990 and 2003, that the 10-year cumulative incidence rate of liver-related mortality or transplantation was 1.9% (95% CI, 0.0%-4.1%) with a prior SVR following treatment and 27.4% (95% CI, 22.0%-32.8%) without a SVR ( $P < .001$ ). Thus, in patients with chronic HCV infection and advanced hepatic fibrosis, a sustained virological response to interferon-based treatment is associated with a lower all-cause mortality rate and obviously a substantial reduction in overall direct and indirect costs of healthcare.<sup>18</sup>

Sievert et al described three different treatment scenarios based upon the anticipated introduction of DAA regimens have been estimated to reduce the overall HCV disease burden.<sup>19</sup> Scenario 1 evaluated the impact of increased treatment efficacy alone estimated to be 80-90% by 2016. Scenario 2 evaluated the increased expected efficacy as well as the increase in numbers of individuals expected to be treated from a value of 2,550 to 13,500 by 2018 without any treatment restrictions. Scenario 3 considered the same increases in efficiency and number expected to be

treated limited to those with fibrotic disease  $\geq$  F3 during the period of 2015-2017. The authors estimated that 233,490 people with chronic HCV infection. This group have included 13,850 individuals with cirrhosis, 590 with hepatocellular carcinoma (HCC) and 530 with liver-related deaths. Scenario 1 would result in a modest reduction in disease burden (4% decrease in HCC, decompensated cirrhosis, and liver deaths) and the overall costs related to these diseases. Scenario 3 had the greatest impact on disease burden projected at a 50% decrease in HCC, decompensated cirrhosis, and liver deaths and overall healthcare costs. Scenario 2 had only a slightly lower impact than did Scenario 3.<sup>19</sup> These data suggest that treatment regimens without any restrictions would result in a substantial reduction in health care costs and simultaneously reduce the number of infected individuals infected who can infect others (Table III).<sup>20,21</sup>

The development of the second-generation protease inhibitors (PIs) had a higher antiviral efficiency as a result of their plurigenotypic range but also as they were more convenient to administer and were associated with fewer side effects.<sup>22</sup> The NS5B inhibitors include nucleoside/nucleotide inhibitors (NIs) and non-nucleotide inhibitors (NNIs). NIs that have even higher efficacy rates and even more useful as they can be used across all genotypes. Sofosbuvir has highly potent antiviral activity across all genotypes when used in association with pegylated interferon and ribavirin (PR). NS5A inhibitors (NS5A) also have potent antiviral activity and when used in combination with protease inhibitors are reported to achieve a SVR in GT-1b prior null responders to a prior interferon-based regimen.<sup>22</sup> Several additional studies have demonstrated that interferon (IFN)-free regimens with DAA agent combinations achieve even higher rates of SVR in naïve as well as treatment-experienced GT-1 patients, who have failed prior interferon based treatment regimes. Moreover, quadruple regimens with peginterferon plus ribavirin (PR) achieve a

SVR in almost all GT-1 null responders. The development of pan-genotypic direct-acting antiviral agents (NIs or NS5A.I) will allow additional new combinations with or without PR that are expected to increase the rate of SVRs for all patient populations regardless of genotype and those with cirrhosis.<sup>22</sup>

## **V. Cost of HCV Treatment and the Need for Timely Therapy**

In contrast to the recommendation for screening for HCV and the subsequent recognition of cases, the use of direct acting antivirals (DAA) therapy has been severely rationed by insurers as well as state and federal agencies. The cost of these drugs can be effectively reduced by an increase of the use of these agents to include all those patients infected with HCV rather than just those with advanced hepatic fibrosis. The rationale for such rationing is that many of those recognized as having the disease will progress slowly over many years, many identified cases will not develop advanced liver disease manifested as advanced chronic hepatitis and cirrhosis (F3-4 cases) and experience any of the multiple complications of their liver disease requiring specific treatment.<sup>23-29</sup>

This reasoning fails to recognize the non-hepatic consequences of hepatitis C infection and the adverse effects of these non-hepatic diseases on patients quality of life. This represents a short sided view of the cost of treatment of hepatitis C related disease (infections) and ignores the long-term costs of hepatitis C treatment consisting of the cost of treatment of cirrhosis, the cost of treatment of decompensated cirrhosis as well as the cost of treatment of hepatocellular carcinoma as well as the cost of liver transplantation and its long-term follow up. These costs far exceed the costs related to the treatment of hepatitis C before any of these complications occurs.

Despite the cost of current or soon to be available 3<sup>rd</sup> and 4<sup>th</sup> generation treatment agents / regimens. In addition, this reasoning ignores the fact that hepatitis C infection is much more than an hepatic disease per se and includes a wide range of extra hepatic disease processes that occur in the absence of clinical liver disease and have extensive direct and indirect costs of their own (Table IV).<sup>30-36</sup> These diseases affect adversely the individual's life quality and potentially longevity. Most importantly, the exclusion of cases with recognized hepatic disease ranging from those with F-0 to F-2 and those with extra hepatic disease processes fails to recognize that these individuals are the principal vectors for new cases of HCV infection. Their treatment would be expected to greatly reduce the numbers of newly infected cases to include those with and without recognized hepatic disease and potentially eliminate the disease in the population at large.<sup>37-48</sup>

The rationing of therapy to those with advanced liver disease, also calls into question the ethical consequences of the recommendations of the CDC and other health related organizations and societies to screen individuals for the disease if no treatment is to be made available to those identified as having the disease. To do so under these circumstances only produces anguish and inappropriate fear in those identified as having the infection.<sup>49</sup>

The alternative approach of recognizing those that have the infection and treating them before they develop clinically evident disease associated with the tremendous costs to society in terms of direct and indirect costs of health care as a result of hepatic as well as the many extra hepatic disease processes known to occur as a result of hepatitis C infection should result in major long term reductions in health care costs.<sup>50</sup> Moreover, by treating these larger populations, the

number of individuals, who unknowingly infect others and perpetuate the infection in the population, would be reduced with even greater overall health care cost reductions. The institution of this alternative approach incorporating a much larger population of infected individuals would make it possible for a marked reduction in cost per unit pill or course of therapy while maintaining the overall profit for pharmaceutical companies, who have expended large amounts of money to bring the drugs to market.<sup>50,51</sup>

Finally, at the day to day clinical level, treatment of patients with stages F0 to/F2/F3 would be expected to be even more efficacious, be better tolerated with fewer cases dropping out of therapy than what would occur by delaying treatment until more advanced stages of liver disease (cirrhosis, hepatic cancer, liver transplant) or not providing treatment at all.<sup>52</sup>

Younossi et al<sup>53</sup> administered a questionnaire to 1923 individuals with chronic hepatitis C, genotype-1, who were enrolled in the ION trials and received HCV treatment (LDV/Sof) with a SVR-12 rate of 93.21%. Reduced work productivity secondary to absenteeism and presenteeism impairments dropped after achieving SVR-12 which would result in a productivity loss saving of 2.7 billion over one-year.<sup>53</sup>

Tandon et al<sup>54</sup>, using a health insurance claims database from January 2001 to March 2012, compared a total of 1,017 patients, who completed interferon therapy and 953 patients, who discontinued therapy. Both resource utilization and healthcare cost analyses indicated that the cohort of patients who completed therapy, was associated with a lower level of health care utilization and overall health care costs as compared to the cohort that failed to complete their therapy. After adjustments for a variety of baseline characteristics, the cohort of patients who

completed therapy experienced statistically significant lower cost allocation of \$3,687 and \$1,644 for all-causes and CHC-related healthcare costs, respectively, relative to those who discontinued therapy.<sup>54</sup>

## **VI. CONCLUSIONS**

Many patients achieve a SVR with PEG-IFN containing therapies. The continued improvements in the ability to obtain a SVR (expected cure) of HCV have been made within the past several years. The principal reason to utilize DAAs is to avoid the side effects of IFN which enhances acceptability, compliance and efficacy of treatment. The enhanced efficacy of these agents and the shorter duration of therapy are additional benefits.

Secondly, considerable increases in the burden of HCV-related advanced liver disease and its complications are expected to be seen in the United States utilizing current treatment regimens. The introduction of improved direct-acting antiviral regimens with enhanced efficacy and a non-restricted requirement for treatment should result in an even greater impact on the total health care costs and reduce the life-long costs of HCV disease management costs. A combination of increased treatment efficacy and greater utilization by treating all presentations of all the disease to include not only those with evident hepatic disease but also those without evidence of liver disease should result in major reductions in the lifetime costs of HCV related disease costs.

Finally, treating all HCV infected patients to include those with and without hepatic disease with DAA regimens will reduce the number of individuals developing advanced liver disease, reduce the cost of treating these cases and more importantly, reduce the cost of

treatment of those with any form of HCV related disease to include not only those with F0-F2 fibrosis of the liver but also those with extra hepatic disease related to HCV infection with or without evidence for coexistent liver disease. Specifically, IFN-free regimens without liver staging requirements and including those without evidence of hepatic diseases but having recognized extrahepatic manifestations of HCV infection is projected to be the most cost-effective approach for treating HCV in all of its varied presentations.



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## **VIII. TABLES**

**Table: I**

### **Individuals at High Risk for HCV Infection**

1. Individuals working in Emergency Departments
2. Anesthesiologists
3. First responders
  - a. Fire
  - b. Police
  - c. Ambulance attendants
4. Individuals undergoing chronic hemodialysis
5. Healthcare workers including employees in dialysis center
6. Institutional residents (prisons, individuals with physical, mental, and developmental abnormalities)
7. Individuals born between 1945-1965
8. Those receiving blood or blood products before 1992
9. Intravenous drug abusers
10. Presence of HIV infection or individuals with high risk sexual behaviors

## **TableII: Goals of Treatment of Hepatitis C**

### **A. Current goals of HCV treatment**

1. Cure HCV infection in those infected with the virus
2. Reduce the downstream consequences of chronic hepatitis C
3. Prevent cirrhosis
4. Prevent decompensation of cirrhosis
5. Prevent hepatocellular carcinoma
6. Reduce the requirement for liver transplantation in individuals with chronic hepatitis C
7. Improve life quality of those with HCV
8. Reduction of all-cause as well as liver disease mortality

### **B. Ideal goals of HCV treatment**

1. Eliminate HCV disease in its all of varied manifestations (both hepatic and extrahepatic)
2. Reduce the number of individuals infected with minimal or no liver disease who are important transmitters of the virus within the population.
3. Improve the life expectancy and quality of those infected with HCV regardless of the specific clinical presentation of their infection.

**Table III:**

**Factors Potentially Contributing to Fibrosis Progression in Individuals with Chronic HCV**

<b>ESTABLISHED FACTORS*</b>	<b>MORE RECENTLY IDENTIFIED RISK FACTORS</b>
Duration of HCV infection	Patient age at time of diagnosis
Older age at infection	Genotype 3 infection
Male gender	Insulin resistance
Presence of baseline fibrosis	Gene polymorphisms involved in inflammation and iron metabolism
HIV coinfection <sup>1</sup> /CD4 count <200 cells/mL	Human leukocyte antigen DRB1*1201-3 allele
Long term alcohol consumption (>20-50 g/day)	Latin ethnicity
HBV coinfection	
Metabolic syndrome (steatosis, insulin resistance, type 2 diabetes)	Daily cannabis use

\*HCV viral load and mode of infection are not associated with faster fibrosis progression

Modified from:

1. Massard J et al. J Hepatol 2006;44(suppl 1):S19-S24
2. Poynard T et al. J hepatol 2001;34:730-739



**TABLE IV**

**Extrahepatic manifestations associated with HCV infection**

- |  |   |
|--|---|
| <ul style="list-style-type: none"><li>• Neuropsychiatric<ul style="list-style-type: none"><li>- Depression</li><li>- Cerebral vasculitis</li></ul></li></ul>                                     | <ul style="list-style-type: none"><li>• Ocular<ul style="list-style-type: none"><li>- Corneal ulcer</li><li>- Uveitis</li></ul></li></ul>   |
| <ul style="list-style-type: none"><li>• Endocrine<ul style="list-style-type: none"><li>- Hypothyroidism</li><li>- Diabetes mellitus</li><li>- Thyroiditis</li></ul></li></ul>                    | <ul style="list-style-type: none"><li>• Autoimmune phenomena<ul style="list-style-type: none"><li>- CREST syndrome</li><li>- Thyroiditis/Hypothyroidism</li><li>- Sicca syndrome</li></ul></li></ul>                                    |
| <ul style="list-style-type: none"><li>• Neuromuscular<ul style="list-style-type: none"><li>- Weakness/myalgia</li><li>- Peripheral neuropathy</li><li>- Arthritis/arthralgia</li></ul></li></ul> | <ul style="list-style-type: none"><li>• Renal<ul style="list-style-type: none"><li>- Membranous glomerulonephritis</li><li>- Nephrotic syndrome</li><li>- Cryoglobulinemia related glomerulonephritis</li></ul></li></ul>               |
| <ul style="list-style-type: none"><li>• Vascular<ul style="list-style-type: none"><li>- Necrotizing vasculitis</li><li>- Polyarteritis nodosa</li><li>- Cryoglobulinemia</li></ul></li></ul>     | <ul style="list-style-type: none"><li>• Hematologic<ul style="list-style-type: none"><li>- Aplastic anemia</li><li>- Thrombocytopenia</li><li>- Non-Hodgkin's B Cell lymphoma</li></ul></li></ul>                                       |
|  | <ul style="list-style-type: none"><li>• Dermatologic<ul style="list-style-type: none"><li>- Porphyria cutanea tarda</li><li>- Lichen planus</li><li>- Cutaneous necrotizing vasculitis</li><li>- Livedo reticularis</li></ul></li></ul> |

Modified from: Jacobson IM et al. Clin Gastroenterol Hepatol 2010;8(11):924-933