Association of Q fever with Autoimmune Hepatitis

Kunatum Prasidthrathsint¹,², Michael D. Voigt³ and Judy A Streit³

1 Department of Pathology, University of Utah Health Sciences Center, Salt Lake City, UT, USA
2 Associated Regional and University Pathologists, Inc, Salt Lake City, USA;
3 Department of Internal Medicine, University of Iowa Hospitals and Clinics, Iowa City, USA

Corresponding author:
Judy A Streit
judy-streit@uiowa.edu
Dept of Medicine, SW54GH, UIHC, 200 Hawkins Dr. Iowa City, Iowa, 52242-1009, USA.
Tel: 319-356-7226

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Abstract

Human infection by Coxiella burnetii, a zoonosis, is associated with the development of autoantibodies, though the clinical significance of these is unclear. We describe two patients with high-titer Q fever antibodies associated with autoimmune hepatitis (AIH) as demonstrated on biopsy and supported by autoantibody results. For one, the chronology of serologic results uniquely demonstrates the development of autoantibodies after Q fever antibodies were detected, providing supportive evidence that Coxiella burnetii infection may have been a trigger for autoimmune hepatitis.

Keywords: Coxiella burnetii; Q Fever; Hepatitis, Autoimmune

Abbreviations: Autoimmune hepatitis (AIH); Anti-nuclear antibody (ANA); Anti-neutrophil cytoplasmic antibody (ANCA); Anti-smooth muscle antibody (ASMA)

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Introduction

Type 1 AIH is characterized by immune dysregulation, wherein autoreactive T-cells injure hepatocytes. One pathogenetic hypothesis of autoimmune disease is that self-tolerance is broken down after exposure to a triggering exogenous antigen which induces cross-reactivity to self-antigens through molecular mimicry. Another hypothesis is that a pro-inflammatory milieu in particular organs can overcome immune tolerance. Infection by various pathogens can potentially trigger autoimmunity through either or both mechanisms. Coxiella burnetii is one pathogen that is often associated with autoimmune antibodies, though uncommonly with clinically relevant autoimmune disease.

Case I

A 31 year-old Hispanic male farm-hand with a history of alcohol use worked with a calving operation. The herd was reported to be infected by Coxiella burnetii, and the patient had direct contact with stillborn calves in the weeks before onset of his illness. He developed intermittent epigastric and bilateral lower abdominal pain, anorexia and nausea with vomiting over 2 months accompanied by a 25-pound weight loss. He denied any fever, chills or night sweats. Liver tests at presentation and subsequent evaluations are shown in (Table 1), demonstrating a marked rise in total and direct bilirubin and markedly elevated transaminases during the early course of his illness. Hepatitis A, B, C and E serologies, Leptospira and Brucella serologies and blood polymerase chain reaction for Epstein Barr Virus and cytomegalovirus were negative. Serum ceruloplasmin and alpha-1 antitrypsin levels were normal. Endoscopic retrograde cholangiopancreatography was unremarkable. Serial results of autoantibody tests are shown in (Table 1), demonstrating negative studies initially. Q fever Phase II IgG showed a 4-fold rise during the first month of evaluation (Table 1). He was diagnosed with Q fever, and doxycycline and levofloxacin were begun. After more than 2 weeks of this therapy, liver enzymes worsened. Antinuclear antibody (ANA) was now low-positive, anti-smooth muscle antibody (ASMA) was highly positive and antineutrophil cytoplasmic antibody (ANCA) was positive. Liver biopsy showed severe acute and chronic inflammation with abundant plasma cells and moderate fibrosis with focal bridging (Figures 1 and 2). No fibrin ring granulomas were identified. Based on laboratory results, history and biopsy results, he was diagnosed with probable AIH based on the revised International Autoimmune Hepatitis Group scoring system (1). Budesonide and azathioprine were initiated in addition to continuation of levofloxacin and doxycycline with marked improvement of transaminase levels. A flare in transaminases when the patient
discontinued his immunosuppressive medications, with prompt resolution after resumption of immunosuppressant medication, further supported a diagnosis of AIH. He received 3 months of antibiotic therapy and remains on immunosuppressant therapy. Q fever serology 22 months after initiation of antibiotic treatment showed sero-reversion.

**Case 2**

A 63 year- old male who lived on and tended to an acreage adjacent to the Mississippi River noted several weeks of diffuse arthralgia followed by dark urine, fatigue and right upper quadrant abdominal pain. He had no known prior autoimmune or liver disease. He was found to have markedly elevated bilirubin and transaminases as shown (Table 1). Complete blood count and basic metabolic panel were unremarkable. Serologies for hepatitis A, B, C, cytomegalovirus and Epstein Barr Virus, *Ehrlichia, Anaplasma, Bartonella* and *Leptospira* were negative. Blood acetaminophen was undetectable and ceruloplasmin and

| Table 1 Laboratory results of patients 1 and 2. |
|-----------------------------------------------|
| Patient 1 | Patient 2 |
| 10/19/2010 | 11/6/2010 | 11/22/2010 | 11/30/2010 | 8/25/2011 | 10/20-25/13 | 11/6/2013 | 2/5/2014 | 5/7/2014 |
| TB | 1.7 | 14.4 | 9.4 | 3.8 | 0.7 | 13.7 | 5.7 | 0.5 | 0.4 |
| DB | 0.5 | 8.5 | 6 | 2 | 0.2 | 7.7 | 2.9 | <0.2 | <0.2 |
| AST | 1,388 | 1,737 | 91 | 113 | 1,480 | 274 | 35 | 48 |
| ALT | 984 | 1,567 | 358 | 146 | 1,245 | 495 | 42 | 35 |
| ALP | 87 | 121 | 132 | 84 | 108 | 193 | 102 | 71 |
| T Prot | 8.8 | 8.1 | 7.6 | 8.5 | 8.3 | 7.9 | 7.9 |
| Ph I IgG | 1:128 | 1:128 | 1:32 | 1:8192 | 1:4096 | 1:4096 |
| Ph II IgG | 1:152 | 1:2048 | 1:128 | 1:4096 | 1:2048 | 1:1024 |
| Ph I IgM | <1:16 | <1:16 | <1:16 | <1:16 | <1:16 | <1:16 |
| Ph II IgM | <1:16 | <1:16 | <1:16 | <1:16 | <1:16 | <1:16 |
| AMA | <0.1 |
| ASMA | Neg | 1:1280 | 1:320 |
| ANA | Neg | <1:140 | 1:40 | <1:180 |
| UC-ANCA | Neg | Positive | Positive | Indeterm. |
| Actin Ab | 133 |
| PBC Ab | 30 |
| LKM Ab | < 1:10 | < 1:10 |

TB: total bilirubin (0.2-1.0 mg/dl); DB: direct bilirubin (0-0.2 mg/dl); AST: aspartate aminotransferase (0-40 U/L); ALT: alanine aminotransferase (0-41 U/L); ALP: Alkaline phosphatase (40-129 U/L); T Prot: total protein (6-8 g/dl); AMA: Antimitochondrial antibody (<0.1); ASMA: antismooth-muscle antibody (<1:40); ANA: antinuclear antibody (<1:40); UC-ANCA: ulcerative colitis anti-neutrophil cytoplasmic antibody (no range found); LKM: liver-kidney microsomal antibody (<1:10); PBC Ab: primary biliary cirrhosis antibody (0-20 U). Empty cells indicate test was not performed.

![Figure 1](image1.png) Case 1 H&E image of liver biopsy (600x) demonstrates severely active hepatitis with prominent plasmacytic inflammation (circled).

![Figure 2](image2.png) Case 1 Trichrome stain of liver biopsy (100x) demonstrates bridging fibrosis and/or necrosis.
alpha 1 antitrypsin levels were normal. Abdominal computed tomography and right upper quadrant ultrasound showed possible cirrhosis with hepatosplenomegaly without biliary dilation. Liver biopsy showed severe active hepatitis with sheets of plasma cells consistent with autoimmune etiology with bridging necrosis. Autoimmune evaluation revealed strongly positive anti-actin antibodies, indeterminate ANCA and negative ANA titers. Primary biliary cirrhosis antibodies were also mildly elevated. On hospital day 4, a diagnosis of probable AIH was made according to the International Autoimmune Hepatitis Group scoring system [1]. He was started on prednisone 60 milligrams daily. Shortly after discharge, Q fever serologies returned and were consistent with chronic Q fever (Table 1). Transesophageal echocardiography did not reveal vegetations or significant valvular dysfunction. Over the next several months, transaminases and bilirubin levels normalized. Because of continued elevated Q fever antibody titers and persistent fatigue, antibiotic therapy directed against Coxiella burnetii was begun approximately 15 months after the diagnosis of AIH.

Discussion

C. burnetii, an obligate intracellular gram-negative coccobacillus, is the cause of Q fever. The organism is acquired primarily through inhalation of aerosols from contaminated soil or excreta of infected animals. The most common clinical manifestations of acute infection are flu-like illness, pneumonia, and hepatitis. The last is typically associated with fibrin ring granulomas on histology and Coxiella antigens can be demonstrated by immunohistochemistry.

Q fever is usually diagnosed by serologic methods. A four-fold rise in Phase II IgG in paired sera provides very high specificity for the diagnosis of acute Q fever [2]. Chronic Q fever is usually diagnosed by high-titer Phase I IgG (≥ 1: 800 by microimmunofluorescence) and at these levels has a 98 % positive predictive value for chronic Q fever [3,4]. The patient described in Case 1 met serologic criteria for acute Q fever, and patient 2 met criteria for chronic Q fever.

Acute infection by Coxiella burnetii has been associated with the production of a range of autoantibodies, including antiphospholipid and antimitochondrial antibodies, ANA, and ASMA [4-6]. The frequency of autoantibodies in some reports of Q fever is very notable: in one study 54% of acutely-infected patients developed at least one of 6 specified autoantibodies, including 29% with ASMA; similarly 67% of chronically-infected patients developed at least one of 6 specified autoantibodies, including 26% with ASMA [4-6]. However, it is unclear whether the Q-fever-associated autoantibodies are epiphenomena or have a pathogenic role in autoimmune illness. Evidence that the autoimmune features of Coxiella infection may be clinically significant includes a recent report of serologically-diagnosed autoimmune liver disease that occurred more than a year after the diagnosis of Q fever by serology. Close to the time of Q fever diagnosis the liver biopsy showed usual changes of Coxiella-associated hepatitis, but the following year with persistent liver function test abnormalities, autoimmune serologies were found to be positive [8]. A more remote report describes a patient with acute Q fever and positive ASMA whose fever resolved only after addition of steroids to the antibiotics, but no liver biopsy was performed [9].

Viruses have primarily been entertained as triggers for autoimmune hepatitis [10]. Theories for viral pathogenesis include molecular mimicry involving viral epitopes similar to liver antigens, the exposure of normally-sequestered self-antigens or the induction of inflammatory cytokine production with increased antigen presentation [11]. Local organ inflammation caused by direct infection is proposed to facilitate the transition from autoimmunity to autoimmune disease [12].

Though the sequence of immune phenomena has been difficult to chart, AIH likely involves an environmental agent that triggers a cascade of T-cell mediated necroinflammation and fibrosis directed at host liver antigens in genetically predisposed hosts. T-regulatory cells are reduced in number and function in the disease [13]. In Type 1 AIH, the more common form, autoantibodies detected include ANA, ASMA, perinuclear antineutrophil antibody and anti-actin antibody. Though the autoantibodies are a hallmark of the disease, the liver antigen(s) targeted by the immune response is not well-defined. A murine model of AIH indicates that an epitope of cytochrome P450IID6 is closely involved with autoimmunity, and studies in human AIH implicate the asialoglycoprotein receptor and soluble liver antigen as targets for autoreactive T cells [14-16].

The possibility that primary autoimmune antibodies led to false-positive Coxiella serology in our patients needs to be considered. Though rheumatoid factor can confound Q fever serologic results, to our knowledge other autoantibodies have not been reported to cause false-positive Q fever serologies. It is unlikely that the Q fever serologies were falsely positive due to an alternate infection given the high titers and the lack of antibodies against related organisms which are reported to share cross-reactive antibodies such as Bartonella or Ehrlichia [17,18].

In summary, we report two patients who had serologic evidence of acute (Case 1) or chronic (Case 2) Q fever, who were also diagnosed with AIH. The clinical sequence for Case 1 is compatible with AIH triggered by acute Q fever. His use of alcohol prior to the diagnosis of liver disease may be a confounding factor for some of the inflammation and fibrosis noted on biopsy, though the abundance of plasma cells and other laboratory features supported the predominance of an autoimmune process. The patient described in Case 2 was diagnosed near-simultaneously with AIH and chronic Q fever. Given that this second patient’s clinical course improved with immunosuppression alone it is not clear that active Coxiella infection of the liver was present at the time of the diagnosis of AIH. Our cases indicate that infection by Coxiella burnetii can be associated with clinical autoimmune disease, and that infection may possibly trigger clinically-significant autoimmunity. Though causation of AIH by Coxiella infection cannot be proved by such a limited numbers of reports, we suggest that in patients with autoimmune hepatitis and an appropriate exposure history, Q fever serologic testing should be considered to better-understand the association with AIH. Alternately, if the hepatitis in Q fever does not improve
with antibiotic treatment, autoimmune liver disease should be considered.

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