

Urticaria and bacterial infections

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ABSTRACT

The association between urticaria and infectious diseases has been discussed for >100 years. However, a causal relationship with underlying or precipitating infection is difficult to establish. The purpose of this work was to perform a systematic analysis of the published cases of urticaria associated with bacterial infections. We give an umbrella breakdown of up-to-date systematic reviews and other important publications on the complex association of urticaria and bacterial infections. We did a Medline search, for English language articles published until January 2014, using the key words "urticaria" and "bacteria/bacterial disease"; a second analysis was performed in groups of bacteria and using each germ name as a key word. Many bacterial infections have been associated with urticaria manifestation, such as Helicobacter pylori, Streptococcus, Staphylococcus, Mycoplasma pneumonia, Salmonella, Brucella, Mycobacterium leprae, Borrelia, Chlamydia pneumonia, and Yersinia enterocolitica. In some cases the skin manifestations, described as urticaria, could be caused by the presence of the microorganism in the skin, or for the action of their toxins, or to the complement activation mediated by circulating immune complexes. Although only a weak association with urticaria of unclear pathogenesis exists, clinicians should consider these bacterial agents in the workup of the patients with urticaria. The eradication of the infection could, in fact, lead to the resolution of urticaria. Prospective studies and well-structured research are obviously needed to better clarify the real role of bacteria in the pathogenesis of urticaria and their relative prevalence.

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Urticaria still represents a challenge to allergists because of the complexity of etiologic factors. Despite progress made to improve our understanding of urticaria pathogenesis and treatment, many patients continue to experience ongoing symptoms and impaired quality of life.^{1,2} Various international urticaria classifications exist based on its duration, frequency, and causes.^{3,4} Table 1 shows a schematic classification of urticaria based on evolution and etiopathogenesis.⁵

According to EAACI/GA²LEN/EDF/WAO guidelines,^{3,4} for patients with urticaria, "a routine evaluation, which should comprise a thorough history and physical examination, and the ruling out of severe systemic disease by basic laboratory tests, should be performed first. Extended diagnostic procedures (e.g., tests for infectious diseases) aimed at the identification of underlying causes should be performed in patients that suffer from longstanding, severe and/or persistent urticaria symptoms."

The association between urticaria and infectious diseases has been discussed for >100 years.⁶ Several chronic persistent bacterial, viral, parasitic, or fungal infections have been suspected to trigger urticarial symptoms in patients with chronic urticaria (CU). The frequency and relevance of infectious diseases vary between different groups of patients and geographical regions.¹ However, a causal relationship with underlying or precipitating infection is difficult to establish, because there is no possibility to challenge the patient with the suspected pathogen.⁷

The purpose of this work was to perform a systematic analysis of the published cases of urticaria associated with bacterial infections.

We give an umbrella breakdown of up-to-date systematic reviews and other important publications on the complex association of urticaria and bacterial infections. We describe important developments and perspectives based on a systematic analysis of the most cited research in this field published in the last 40 years.

We did a Medline search, for English language articles published until January 2014, using the key words "urticaria" and "bacteria/bacterial disease"; a second analysis was performed in groups of bacteria and using each germ name as a key word. Table 2 shows the main studies reporting the association between urticaria and bacteria.

HELICOBACTER PYLORI

The most reported bacterial infection associated with urticaria is a *Helicobacter pylori* infection. There are

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Table 1 Clinical classification of urticaria

On the basis of evolution
Acute—up to 6 wk of continuous activity
Chronic—>6 wk of continuous activity
Episodic—acute intermittent or recurrent activity
On the basis of etiopathogenesis
Immune pathogenesis
Type I immunoreactions—food, drugs, inhalant, parasites, and Hymenoptera venom
Type II immunoreactions—transfusional reactions
Type II immunoreactions—vasculitis, serum sickness, autoimmune diseases, serum, and immunoglobulins infusion
Autoimmune
Not defined immune pathogenesis
Infections
Parasites
Cancer
Extraimmunological pathogenesis
Histamine-releasing substances
Physical urticaria
Psychogenic urticaria
Contact urticaria
Other factors
4 Hereditary pathogenesis
Hereditary angioedema
Cold (familial or delayed)
Localized heat urticaria
With deafness and amyloidosis (Muckle-Wells syndrome)
Familial vibratory angioedema
Erythropoietic protoporphyria with solar urticaria
C3b-inactivator deficiency
Carboxypeptidase N deficiency

several pro and contra reports about the relief of urticaria symptoms after *H. pylori* eradication. Although *H. pylori* eradication has been recommended as part of routine CU management, the trials of *H. pylori* eradication in the treatment of CU have yielded conflicting results and suffer from substantial methodological limitations.⁸

In a systematic review published in 2003 that included studies dating back to 1983, 10 studies met the inclusion criteria.⁹ It was found that 30.9% of patients recovered from urticaria after *H. pylori* eradication, 21.7% recovered without infection eradication, and 13.5% recovered without *H. pylori* infection. Hence, only one-third of patients with *H. pylori*-associated CU presented remission. Therefore, because *H. pylori* infection is very common, in many patients CU might have other causes, even in the presence of active *H. pylori*

infection. Another pitfall evidenced by the review is that some studies enrolled patients with positive serology for *H. pylori*, this test is considered inadequate to reveal active infection. The authors concluded that clinicians, after considering other causes of urticaria, should consider testing for *H. pylori*, treating with appropriate antibiotics if *H. pylori* is present, and confirming successful eradication of infection.⁹

Another review published in 2009⁷ differentiated studies showing a benefit of *H. pylori* eradication for CU and studies not showing a benefit. The first part included 13 studies; 84% of eradicated patients showed significant improvement or complete remission of CU, in contrast to 45% of untreated *H. pylori*-positive and 29% of untreated *H. pylori*-negative patients. The nine studies not showing a benefit of *H. pylori* eradication for CU presented urticaria improvement or remission in 25% of patients after *H. pylori* eradication, 27% in untreated *H. pylori*-positive patients, and 38% in untreated patients without infection.

The total results of all studies showed 61% of urticaria remission in eradicated patients, 33% in noneradicated patients, and 30% in *H. pylori*-negative patients. Therefore, the benefit of *H. pylori* eradication is higher compared with that presented in the previous review.

A comprehensive review published in 2010 used the Grading of Recommendations Assessment, Development, and Evaluation approach to analyze and determine the quality of evidence for *H. pylori* eradication for CU treatment.⁸ The review includes 10 trials reporting the benefit of *H. pylori* eradication in patients with CU and 9 studies showing no benefit. The authors concluded that the evidence that *H. pylori* eradication improves CU outcomes is weak and conflicting; therefore, routine *H. pylori* eradication for patients with CU can hardly be recommended.⁵ For this reason, a decision to proceed with this management should be carefully considered in the context of relative harms/burdens and benefits.

Nevertheless, studies about the association between *H. pylori* and CU still continue to be published. A recent study showing a complete remission of urticaria in 63.6% of patients after *H. pylori* eradication indicated that different virulent genotypes of *H. pylori* are irrelevant concerning remission of urticaria after eradication.¹⁰

Another study evaluated the role of *H. pylori* eradication in patients with antihistamine-resistant CU⁸: 63% of patients had a positive ¹³C-urea breath test for *H. pylori*. After infection eradication 28% of patients showed a significant reduction in the urticaria activity score and a complete remission. None of patients who refused eradication therapy achieved complete remission. However, these results do not exclude spontaneous remission of urticaria.¹¹

Other recent studies reported a weak benefit of *H. pylori* eradication on urticaria.^{12,13} One showed a sim-

Table 2 Reported association between urticaria and bacterial infections

Bacterium	Type of Urticaria	Population	Urticaria/Infection Association (rate)	Urticaria Remission/Improvement after Infection Eradication (rate)	Rate of Urticaria Remission in Untreated Patients	First Author	Type of hymenoptera (no. of studies involved)	Reference No.
<i>Helicobacter pylori</i>	CU	Adults and children	Rate not stated	30.9%	21.7%	Federman DG	Review (10)	6
	CU	Adults	Rate not stated	84%	45%	Wedi B	Review (13)	4
	CU	Adults	Rate not stated	25%	27%	Wedi B	Review (9)	4
	Chronic spontaneous urticaria	Adults	Rate not stated	63.6%	Not stated	Chiu YC	Study	7
	Antihistamine-resistant CU	Adults	63%	28%	0%	Magen E	Retrospective study	8
<i>Streptococcus</i>	CU	Adults	30.5%	20% remission; 33% improvement	Not stated	Akashi R	Study	9
	CU/recurrent angioedema	Adults	68%	20%	10%	Kolacinska-Flont M	Study	10
	AU	Children	40.6%	100%	NA	Schuller DE	Study	13
	Acute recurrent urticaria/acute angioedema/CU	Adults	71.4%	71.42%	28.57	Calado G	Retrospective study	16
	Recurrent urticaria	Adult	Yes	Yes	NA	Edward A	Case report	17
<i>Staphylococcus</i>	AU	Adult	Yes	Yes	NA	Nousari HC	Case report	18
	Recurrent urticaria	Adults	88.8%	75% remission; 25% improvement	Not stated	Bonanni L	Study	20
	CU	Adults and children	53.2%	Not stated	Not stated	Ertam I	Study	21
	CU	Adults	56.14%	28.12% remission; 12.5% improvement	Not stated	Sharma AD	Clinic-based study	22
	Antihistamine-resistant AU	Children	32%	100%	NA	Wu CC	Study	26
<i>Mycoplasma pneumoniae</i>	AU	Child	Yes	Yes with antihistamine therapy	NA	Kano Y	Case report	28
	Urticaria vasculitis	Adult	Yes	Yes with ibuprofen therapy	NA	Dua J	Case report	29
	Urticaria vasculitis	Adult	Yes	100%	NA	Jover F	Case report	30
	Non-episodic angioedema with eosinophilia	Adult	Yes	Partial	NA	Stockner I	Case report	32
	Recurrent urticaria	Adult	Yes	Yes	NA	Tachdjian R	Case report	34
<i>Salmonella</i>	Urticaria	Child	Yes	Not stated	NA	Mittal S	Case report	35
	Urticaria-like papules and plaques	Adults and children	35.3%*	Not stated	Not stated	Metin A	Study	37
	Urticaria-like erythematous plaques	Adult	Yes	Yes	NA	Song Z	Case report	42
	Erythematous papules and plaques#	Adult	Yes	NA	NA	Booth AV	Case report	43
	Erythematous plaques#	Adult	Yes	NA	NA	Stafford SJ	Case report	44
<i>Brucella</i>	Multiple urticaria-like wheals#	Adult	Yes	NA	NA	Barman KD	Case report	45
	CU	Not stated\$	33.3%	Not stated\$	Not stated\$	Svecova D	Study	48
	Urticaria-like	Children	25%	Not stated\$	Not stated\$	Passos SD	Cross-sectional study	49
	Urticarial vasculitis	Child	Yes	Not stated	NA	Olson JC	Case report	50
	Pigmented urticarial erythema	Not stated\$	Yes	Yes	NA	Merkle T	Case report	51

Continued

Table 2 Continued

Bacterium	Type of Urticaria	Population	Urticaria/ Infection Association (rate)	Urticaria Remission/ Improvement after Infection Eradication (rate)	Rate of Urticaria Remission in Untreated Patients	First Author	Type of hymenoptera (no. of studies involved)	Reference No.
<i>Chlamydia pneumoniae</i>	Acute and CU	Children	9.25%	Not stated	Not stated	Sackesen C	Prospective study	15
Antihistamine- and corticosteroid-resistant angioedema		Child	Yes	Yes	NA	Uysal P	Case report	52
<i>Yersinia enterocolitica</i>	CU	Adults	4.65%	Not stated	Not stated	Wedi B	Study	53
	CU	Not stated	53.5%	Not stated	Not stated	Hellmig S	Controlled study	54

*Urticaria rate in patients with infectious disease.

#Misdiagnosed as CU.

§Article in foreign language; data not present in the English abstract.

AU = acute urticaria; CU = chronic urticaria.

ilar presence of *H. pylori* antigen in patients with CU and healthy controls. Moreover, the *H. pylori* eradication therapy was not effective for treating urticaria.¹³

It has been 30 years since *H. pylori* was isolated, but the association with urticaria is still controversial. Several factors may explain the discrepancy between the results of the studies such as the different methods used for the detection of *H. pylori* infection; *H. pylori* antibodies are associated with active gastritis in only some patients, thus the assessment of antibodies does not indicate active disease; and the resistance of *H. pylori* to therapy and recurrence shortly after successful therapy.¹⁴

Therefore, more randomized and case-control studies need to be performed to clarify the association between *H. pylori* and urticaria.

STREPTOCOCCUS spp

Streptococcus spp (S) infections such as pharyngitis, tonsillitis, cystitis, peritonitis, and rheumatic fever have sometimes been reported as a cause of acute, recurrent, or CU.^{15–21} Antistreptococcal antibodies have been described in 10–42% of patients with CU.⁶

In 1964 antistreptolysin titers were reported significantly more common in acute urticaria (AU) compared with controls.¹⁵ In a study in 1967 15 of 16 children with CU presented with pharyngitis, tonsillitis, sinusitis, and otitis often caused by *Streptococcus* spp and *Staphylococcus* spp.²² After antibiotic therapy urticaria was present in a high rate of patients. A study in 1980 reported a streptococcal pharyngitis in 40.6% of patients with AU, apparently not related to other causative factors.¹⁶ Another study enrolled nine patients with recurrent urticaria.²³ Eight of nine patients without other known causes of urticaria showed a high antipolysaccharide group-specific IgG antibody titers to *Streptococcus pyogenes*. After antibiotic treatment all patients recovered or improved. However, four of these patients also had an *H. pylori* infection treated with colloidal bismuth together with antibiotic therapy for *Streptococcus*.²³ In these studies streptococcal infections were not clinically apparent.

In a retrospective study of 14 patients with recurrent CU and AU a link between streptococcal tonsillitis was identified.¹⁹ All patients denied a clinical relationship between urticaria and underlying infections at the first consultation. Later, 71.4% of patients recognized that urticaria exacerbations were coincident with tonsillitis. However, given the high prevalence of urticaria and streptococcal tonsillitis, they can coexist independently. Nevertheless, in this study, the relationship between the two entities is supported by the markers of *S. pyogenes* infection in all patients, the perception of a clinical relationship between tonsillitis and urticaria, the decrease of urticaria severity with antibiotic therapy, and urticaria resolution after tonsillectomy.¹⁹

A case of recurrent urticaria has been reported to be linked to *S. Peritonitis*.²⁰ A woman with end-stage renal disease and maintained on continuous ambulatory peritoneal dialysis twice developed urticaria before developing peritonitis. After the first episode, the culture of the peritoneal fluid showed γ -hemolytic *Streptococcus*. The culture of peritoneal fluid during the second episode was negative; however, a throat culture was positive for β -hemolytic *Streptococcus*. After long antibiotic therapy there was no recurrence of infection and urticaria.²⁰

An unusual case of acute rheumatic fever has been reported associated to AU.²¹ Urticaria is not a classic skin manifestation of acute rheumatic fever. The biopsy specimen in this case showed typical findings of AU; this excluded all other differential diagnoses. After antibiotic, corticosteroid, and aspirin therapy the patient recovered.²¹

STAPHYLOCOCCUS spp

Together with tonsillitis, sinusitis is present in almost 50% of patients with urticaria.¹⁷ Sinusitis is predominantly caused by *Staphylococcus aureus*. A study reported the presence of *S. aureus* in nasal swab specimens of 53.2% of patients with CU and in 13.3% of healthy controls.²⁴ These results showed only a high nasal carriage of *S. aureus* in patients with CU; however, the authors did not specify if the patients recovered from urticaria after antibiotic therapy.²⁴ In another study *S. aureus* was detected in nasal swab specimens in 56.14% of patients with CU and in 28% of healthy subjects.²⁵ After antimicrobial treatment, 28.12% of patients completely recovered from urticaria; 12.5% partially recovered and 59.37% continued to suffer from urticaria. This study shows that although there was a high prevalence of nasal *S. aureus* in patients with CU, about one-third of the total cases received benefit from antimicrobial therapy. The lower rate of patients with only partial relief from urticaria indicates the presence of multiple etiologic factors. Therefore, in these cases the nasal carriage of *S. aureus* would act as an aggravating factor in the course of urticaria.²⁶

It is known that antistaphylolysin antibodies have been described in 1–10% of patients with CU.⁶ Moreover, serum IgE antibodies against the staphylococcal enterotoxin A, staphylococcal enterotoxin B, and toxic shock syndrome toxin 1 were also reported in patients with urticaria.²⁷ In another study, specific IgE for staphylococcal enterotoxin A, staphylococcal enterotoxin B, and toxic shock syndrome toxin 1 were detected, respectively, in 14.6, 13.1, and 19.8% of patients with CU and in 5% of healthy controls.²⁸

MYCOPLASMA PNEUMONIAE

In literature *Mycoplasma pneumoniae* has been reported to be associated with different types of urticaria. The association of *M. pneumoniae* with AU is frequent in children.^{29–31} In a Taiwanese study in 2009 32% of children with AU who were unresponsive to antihistamine treatment and avoidance of food allergens showed serological evidence of *M. pneumoniae* infection.²⁹ After antimicrobial therapy these patients needed a statistically significant shorter time for improvement and complete resolution of urticaria. In an Italian study in 2004, 14.6% of children who were diagnosed with pneumonia due to *M. pneumoniae* infection presented urticaria alone or with arthralgia as exclusive extrapulmonary manifestation.³⁰ In adults the association between *M. pneumoniae* infection and AU is anecdotal. This probably happens because the host responses in adults may differ from those in children.³¹ Indeed, in 2007 a report about three patients with *M. pneumoniae* infection in a single family was published; they presented diverse skin manifestations: the mother presented with erythema nodosum, the 11-year-old daughter presented with anaphylactoid purpura, and the 9-year-old son presented with AU.³¹ The authors concluded that the age-related variations in cutaneous manifestations of *M. pneumoniae* infections could be attributed to immaturity of the adaptive immunity of a host, as has been suggested in viral infections.³¹

Cases of other types of urticaria have also been reported, such as urticaria vasculitis,^{32,33} urticaria a frigore,³⁴ and a case of angioedema.³⁵ The first case of urticarial vasculitis was reported in a woman with atypical pneumonia due to *M. pneumoniae* infection³³; the diagnosis was made by biopsy of the lesions. The second case described a patient with *M. pneumoniae* infection presenting with extrapulmonary manifestations and urticarial vasculitis, which was misdiagnosed as adult-onset Still's disease.³² The peculiarity of the case of angioedema³⁵ was that the *M. pneumoniae* infection was followed by nonepisodic angioedema with eosinophilia, fever, weight gain, and elevated serum IgM, a variant of the disease reported by Gleich.³⁶

SALMONELLA spp

There are very few reports of a possible association between *Salmonella* infection and urticaria. An interesting case of urticaria associated with *Salmonella* infection of uterine leiomyomas was described in 2010.³⁷ A woman presented an 18-year history of recurrent symptoms of fever, chills, headache, dizziness, and diarrhea followed by the appearance of urticaria. The patient underwent a hysterectomy for the presence of several leiomyomas. The largest one presented a purulent content. The culture of the purulent content grew

previously untyped *Salmonella*. Urticaria resolved after removing the necrotic tissue.

Previously, another case of unusual presentation of *Salmonella typhi* infection had been reported.³⁸ A five-year-old girl presented with a 2-day history of fever, headache, and a fleeting, itchy, annular and raised macular rash most prominent over the face, upper chest, and the lower limbs. The blood culture grew *S. typhi*.³⁸

BRUCELLA spp

Clinical manifestations of brucellosis include a variety of cutaneous eruptions present in 1–14% of cases.³⁹ These lesions are nonspecific and usually appear as disseminated erythema, diffuse maculopapular eruption, papulonodular lesions, erythema nodosum-like eruption, psoriasiform eruption, malar eruption, palmar erythema and eczema, purpura, vasculitis, etc.³⁹

Only two reports in literature describe skin manifestations of brucellosis as urticaria.^{40,41} The first study reports that 35.3% of patients with cutaneous findings attributable to brucellosis presented urticaria-like papules and plaques.⁴⁰ Another study reports a rate of 3.85% of urticaria in patients with abortion because of brucellosis.⁴¹ However, brucellosis presentation is generally with systemic symptoms; therefore, skin manifestations are usually accompanied by other symptoms. Patients with brucellosis showing a cutaneous manifestation as the only or the first feature are rare,^{42–44} but none of these reports include urticaria. Only in some patients with subacute or chronic disease, who refer directly to the Dermatologic or Allergologic Clinic for exclusive skin lesions, could the diagnosis be difficult and frequently missed.⁴⁰

MYCOBACTERIUM LEPRAE

Borderline leprosy can show up with distinct forms and/or numbers of eruptions in asymmetric distribution, including wheals-like, annular or bizarre-shaped edematous maculopapule and erythematous plaque that could mimic disease with urticarial eruptions.⁴⁵ In the literature there are some case reports about urticaria-like lesions as the first manifestation of leprosy.^{45–48} In all cases the manifestations were misdiagnosed as chronic idiopathic urticaria and treated with conventional therapy without improvement. The biopsy led to the correct diagnosis.

BORRELIA

Although the typical erythema migrans is a relatively easy-to-recognize manifestation of *Lyme borreliosis*, it is by no means the only cutaneous manifestation of infection with *Borrelia*, but unclear unspecific cutaneous lesions as urticaria can be present.^{49,50} In a Slovakian study among 57 patients with CU, antibodies

against *Borrelia burgdorferi* were found in one-third of patients.⁵¹ In a pediatric study the rate of urticaria-like lesions was 25% in children with skin rash and fever and with a positive test for borreliosis.⁵² Cases of urticarial vasculitis²⁵ and pigmented urticarial erythema⁵³ were also reported as an unusual manifestation of *Lyme borreliosis*.

CHLAMYDIA PNEUMONIAE

Chlamydia pneumoniae infection has been rarely reported as associated to urticaria. However, in a pediatric study in 2004, 9.25% of children with AU or CU showed positive *C. pneumoniae* IgM.¹⁸ Moreover, in children without signs and symptoms suggesting infection, positive serology for *C. pneumoniae*, together with serology for *H. pylori* and urinary tract infections, were more common than in children with infectious symptoms.

C. pneumoniae has also been recently associated with angioedema.⁵⁴ A 13-year-old boy, with antihistamine- and corticosteroid-resistant angioedema presented serological tests compatible with acute chlamydial infection. During antibiotic therapy the angioedema started to regress and no symptoms reappeared in the follow-up period.⁵⁴

YERSINIA ENTEROCOLITICA

Yersinia enterocolitica has sometimes been associated with CU.^{55,56} In a group of 43 patients with CU and potential infectious triggers, *Yersinia* infection has been detected in two patients (5%).⁵⁶ Other authors found *Y. enterocolitica* IgA and IgG antibodies in 53.5% of patients with CU, a higher rate than that reported in healthy controls (43%).⁵⁵ Another work reported specific antibodies against *Y. enterocolitica* in 31 patients among 74 *H. pylori*-positive patients with CU (42%).⁵⁷

FOCAL INFECTIONS

Foci of infections have been described as sinuses, adenoids, tonsils, teeth, genitourinary tract, gall bladder, and kidneys.⁵⁸ Several studies show an increased incidence of tonsillitis, sinusitis, and dental infections among patients with CU.

Studies about focal infections caused by *Staphylococcus* and *Streptococcus* have already been mentioned in this article. Other studies showed the association between urticaria and focal infections without mentioning the infectious agents involved. Sinusitis has been associated with CU in 32% of cases, dental infections in 29%, and tonsillitis and sinusitis in 50% of cases.^{17,59} In a study in 1998 infection-like sinusitis, throat, and dental infection, were revealed in 15% of patients with CU; 37.5% of them presented milder symptoms after infection treatment.⁶⁰ A recent study reported that 35.7% of patients with urticaria had at least one type of dental,

sinus, and urogenital tract infections.⁵⁸ A pediatric study reported a positive throat culture in 8% of single-episode AU and in 8% of recurrent AU and a positive urine culture in 6% of single-episode AU and in 6% of CU.¹⁸ Other case reports described complete remission of CU after elimination of dental focal infections.⁷ However, other studies did not find a significant association between CU and dental and sinus focal infections.^{61,62}

CONCLUSION

Many bacterial infections have been associated with urticaria manifestation, the pathogenesis remains generally unexplained. In some cases the skin manifestations, described as urticaria, could be caused by the presence of the microorganism in the skin (*B. burgdorferi*, and *Mycobacterium leprae*), or for the action of their toxins (*Streptococcus* spp and *Staphylococcus* spp) or to the complement activation mediated by circulating immune complexes (*Streptococcus* spp).

Although only a weak association with urticaria of unclear pathogenesis exists, clinicians should consider these bacterial agents in the workup of the patients with urticaria. The eradication of the infection could, in fact, lead to the resolution of urticaria. Prospective studies and well-structured research are obviously needed to better clarify the real role of bacteria in the pathogenesis of urticaria and their relative prevalence.

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