

POSITION PAPER

The definition, diagnostic testing, and management of chronic inducible urticarias – The EAACI/GA²LEN/EDF/UNEV consensus recommendations 2016 update and revision

M. Magerl¹, S. Altrichter¹, E. Borzova², A. Giménez-Arnau⁴, C. E. H. Grattan³, F. Lawlor³, P. Mathelier-Fusade⁵, R. Y. Meshkova⁶, T. Zuberbier¹, M. Metz¹ & M. Maurer¹

¹Department of Dermatology and Allergy, Allergie-Centrum-Charité, Charité – Universitätsmedizin Berlin, Berlin, Germany; ²Department of Clinical Allergology, Russian Medical Academy of Postgraduate Education, Moscow, Russia; ³Cutaneous Allergy, St John's Institute of Dermatology, St Thomas' Hospital, London, UK; ⁴Department of Dermatology, Hospital del Mar, Institut Mar d'Investigacions Mèdiques IMIM, Universitat Autònoma Barcelona, Barcelona, Spain; ⁵Service de Dermatologie et Allergologie, Hôpital Tenon, Paris, France; ⁶Klinika Medicinskoy Immunologii I Allergologii, Smolensk, Russia

To cite this article: Magerl M, Altrichter S, Borzova E, Giménez-Arnau A, Grattan CEH, Lawlor F, Mathelier-Fusade P, Meshkova RY, Zuberbier T, Metz M, Maurer M. The definition, diagnostic testing, and management of chronic inducible urticarias – The EAACI/GA²LEN/EDF/UNEV consensus recommendations 2016 update and revision. *Allergy* 2016; **71**: 780–802.

Keywords

chronic inducible urticaria; physical urticaria; cholinergic urticaria.

Correspondence

Marcus Maurer, Department of Dermatology and Allergy, Allergie-Centrum-Charité, Charité – Universitätsmedizin Berlin, Charité-platz 1, 10117 Berlin, Germany.
Tel.: + 49 30 450 518 043
Fax: + 49 30 450 518 972
E-mail: marcus.maurer@charite.de

Abstract

These recommendations for the definition, diagnosis and management of chronic inducible urticaria (CIndU) extend, revise and update our previous consensus report on physical urticarias and cholinergic urticaria (Allergy, 2009). The aim of these recommendations is to improve the diagnosis and management of patients with CIndU. Our recommendations acknowledge the latest changes in our understanding of CIndU, and the available therapeutic options, as well as the development of novel diagnostic tools.

Accepted for publication 9 March 2016

DOI:10.1111/all.12884

Edited by: Werner Aberer

These recommendations for the definition, diagnosis, and management of chronic inducible urticaria (CIndU) extend, revise, and update our previous consensus report on physical urticarias and cholinergic urticaria (1), a joint initiative of the EAACI (European Academy of Allergology and Clinical Immunology) Dermatology Section, the GA²LEN (Global Allergy and Asthma European Network) task force on urticaria, the EDF (European Dermatology Forum), and UNEV (urticaria network e.V.). Changes to the 2009 consensus report reflect the results of studies published since then.

Chronic inducible urticarias

Chronic inducible urticarias (CIndUs) are a subgroup of chronic urticaria, a group of diseases characterized by the

recurrence of itchy wheals and/or angioedema for longer than 6 weeks [Table 1, (2)]. Most CIndUs present with wheals, angioedema, or both. Within the group of CIndU, symptomatic dermographism/urticaria factitia, cold and heat urticarias, delayed pressure urticaria, solar urticaria, and vibratory angioedema are defined as physical urticarias. Nonphysical CIndUs include cholinergic urticaria, contact urticaria, and aquagenic urticaria. CIndUs, in contrast to chronic spontaneous urticaria (CSU), are characterized by the need for specific triggers for wheals, angioedema, or both of these symptoms to develop. Wheals and angioedema in CIndU patients develop only and reproducibly in response to the trigger stimulus that is specific for their condition (e.g., cold exposure in cold urticaria). CIndU signs and symptoms are usually confined to skin areas that are exposed to the

Table 1 Classification of urticarias

Chronic urticaria subtypes	
Chronic spontaneous urticaria	Chronic inducible urticaria
Spontaneous appearance of itchy wheals, angioedema, or both ≥ 6 weeks due to known* or unknown causes	Physical urticaria Symptomatic dermographism† Cold urticaria‡ Delayed pressure urticaria§ Solar urticaria Heat urticaria¶ Vibratory angioedema Other inducible urticaria Cholinergic urticaria Contact urticaria Aquagenic urticaria

*For example, autoreactivity, that is, the presence of histamine-releasing autoantibodies; †also called urticaria factitia, dermographic urticaria; ‡also called cold contact urticaria; §also called pressure urticaria; ¶also called heat contact urticaria.

specific trigger. Individual patients may exhibit two or more CIndUs, and in rare cases, two or more concurrent triggers are needed to produce urticarial signs and symptoms. It is important to accurately identify and characterize the eliciting trigger and individual trigger thresholds and to distinguish CIndUs from CSU (Table 1). Cholinergic urticaria, contact urticaria, and aquagenic urticaria, in contrast to physical urticarias, are not triggered by a physical factor, but by active and passive warming, in the case of cholinergic urticaria and by skin contact with wheal-/angioedema-inducing substances and water in contact urticaria and aquagenic urticaria, respectively. Rare variants and atypical forms of CIndU exist (e.g., delayed dermographism, cholinergic dermographism, cold-dependent dermographism, cold-induced cholinergic reflex urticaria, and others), but are not included in this set of recommendations.

CIndUs are diagnosed based on the patient history and the results of provocation testing. In all patients with a history suggestive of CIndU, provocation testing should be performed if possible to confirm the diagnosis. Patients with severe CIndU may develop systemic signs and symptoms during provocation testing. These can range from dizziness, vertigo, vomiting/diarrhea, and wheezing up to anaphylactic shock. As a consequence, provocation testing in CIndU patients should be carried out only by physicians trained and experienced in the emergency treatment of allergic responses and where facilities for emergency treatment are available.

Because CIndU patients may exhibit more than one subtype of urticaria, all CIndU triggers suspected to be relevant (e.g., heat, cold, UV, pressure, vibration, stroking, exercise) should be tested. In patients with CIndU who also exhibit CSU, the latter should be diagnosed and managed as recommended by the current version of the international guideline (2). Similar to CSU (3, 4), CIndUs can cause severe quality

of life impairment, and CIndUs may have important occupational and employment implications.

General recommendations for the diagnostic workup in CIndU patients

The diagnosis of CIndU relies on a thorough history and provocation testing. Although the eliciting triggers of inducible urticarias can usually be identified, their underlying causes are unknown (except contact urticaria). Differential diagnoses such as autoinflammatory disorders and bradykinin-mediated angioedema can usually be ruled out from the history (5). The diagnostic workup in CIndU is therefore aimed at confirming the diagnosis and assessing disease activity. The results of provocation testing are influenced by a number of factors including patients' treatment. As a consequence, symptomatic treatment should be discontinued prior to testing if possible. Antihistamines should be stopped at least 3 days before testing (allowing five plasma half-lives of drug elimination) and glucocorticosteroids 7 days before testing. Some patients may not tolerate stopping treatment before provocation testing and, in these, provocation responses must be interpreted with caution.

The aims of provocation testing were to 1. determine the relevant trigger(s) in individual patients and 2. assess trigger thresholds. Trigger threshold measurements are useful for counseling patients on the avoidance of relevant triggers as well as for measuring and monitoring treatment responses. Testing of provocation triggers and thresholds should therefore be carried out before and during therapy. Repeated provocation tests can help to optimize treatment. Testing should be carried out at skin sites that were not affected by urticaria in the last 24 h. This is because such skin sites may exhibit unresponsiveness during a refractory period after urticarial reactions. In patients with cholinergic urticaria, provocation testing should be carried out after at least 24 h of the absence of symptoms. Provocation tests in physical urticaria should be performed at the recommended skin sites (Fig. 1). This allows for comparing test results with those in other patients and published results. In patients with negative provocation responses, but a strong suspicion of CIndU from the history, the test should be repeated. In such cases, skin sites that, according to the patient, have previously but not recently (within the last 3 days) been affected, should be used, and patients should be reassessed for the use of any medication that may suppress test reactions. In some patients with CIndU, the diagnosis cannot be confirmed by standard provocation testing although the clinical history is highly suggestive.

Usually, provocation testing, in positive patients, results in the rapid development of urticarial reactions. In cold urticaria and symptomatic dermographism, for example, wheals usually develop within minutes after provocation. An exception to this rule is the onset of positive test responses in delayed pressure urticaria. Here, it is necessary to wait for several hours, and it may therefore be advisable to rely on patients to report positive provocation test response.

Patient information

Name: _____

Date of birth: _____

Abbreviations: W = Wheal
E = Erythema
A = Angio-edema
I = Itch

Document skin reaction with + or -

Provocation tests for inducible urticaria

Symptomatic dermatographism (Urticaria factitia)

Testsite: Volar forearm or upper back
 Test: Moderate stroking of the skin with a blunt smooth object (e.g. closed ballpoint pen tip, wooden spatula), dermatographic tester (36 g/mm²), or FricTest (longest pin)
 Reading time: 10 minutes after testing

W	I

Date / Time _____ Test done by _____
Positive test = wheal & itch: Test trigger strength threshold →

Cold urticaria

Testsite: Volar forearm
 Test: Melting ice cube in thin plastic bag, TempTest (4-44°C) for 5 minutes
 Reading times: 10 minutes after testing

W

Date / Time _____ Test done by _____
Positive test = wheal: Test temperature threshold →

Heat urticaria

Testsite: Volar forearm
 Test: Heat source, TempTest (44-4 °C) for 5 minutes
 Reading times: 10 minutes after testing

W

Date / Time _____ Test done by _____
Positive test = wheal: Test temperature threshold →

Delayed pressure urticaria

Testsite: Shoulder or upper back or thighs or volar forearm
 Test: Suspension of weights over shoulder (7 kg, shoulder strap width: 3 cm) for 15 min or weighted rods (1.5 cm diameter: 2.5 kg; or 6.5 cm diameter: 5 kg) for 15 min. Dermographic tester at 100 g/mm² for 70 sec
 Reading times: ≈6 hours after testing

A	E

Date / Time _____ Test done by _____
Positive test = angio-edema & erythema: Test trigger strength threshold →

Solar urticaria

Testsite: Buttocks
 Test: UVA 6 J/cm² & UVB 60 mJ/cm² (e. g. Saalman Multitester SBC LT 400) & visible light (projector)
 Reading times: 10 min after testing

	W
UVA	
UVB	
Visible light	

Date / Time _____ Test done by _____
Positive test = wheal: Test trigger strength threshold (UVA / UVB) →

Vibratory angio-edema

Testsite: Volar forearm
 Test: Vortex vibrator for 5 minutes, 1000 rpm
 Reading times: 10 minutes after testing

A	W

Date / Time _____ Test done by _____
Positive test = angio-edema or wheal

Cholinergic Urticaria

Test 1: Exercise machine, e.g. bicycle trainer or treadmill. Exercise for 30 min, increase pulse rate by 3 beats/min every minute, **positive test = wheals. If positive, wait > 24 hours and perform**
Test 2: 42 °C bath, monitor body temperature. Continue bath for 15 min after body temperature has increased by ≥ 1°C over baseline
 Reading times: During test as well as immediately and 10 minutes after end of test

Test 1.	W	How long after begin of test?
Exercise		_____ minutes

→

Test 2.	W
Hot bath	

Figure 1 Documentation of CIndU provocation tests.

Patient information

Name: _____

Date of birth: _____

Abbreviations: W = Wheal
E = Erythema
A = Angio-edema
I = Itch

Document skin reaction with + or -

Threshold tests for inducible urticaria**Symptomatic dermographism (Urticaria factitia)**

Testsite: Volar forearm or upper back
Test: Use a dermatographometer (e.g. dermatographic tester or FricTest)
Reading time: 10 minutes after testing
Threshold: Lowest trigger strength that results in wheal and itch

FricTest	W	I
Pin 1 (shortest)		
Pin 2		
Pin 3		
Pin 4 (longest)		

Dermatographic tester	W	I
Minimum trigger strength in g/mm ²	g/mm ²	g/mm ²

Test done by _____

Date / Time _____

Cold urticaria

Testsite: Volar forearm
Test: Use TempTest for 5 minutes
Reading time: 10 minutes after end of testing
Threshold: Highest temperature that results in wheal

Wheal from 4°C to _____ °C

Test done by _____

Date / Time _____

Heat urticaria

Testsite: Volar forearm
Test: Use TempTest for 5 minutes
Reading time: 10 minutes after end of testing
Threshold: Lowest temperature that results in wheal

Wheal from 44°C to _____ °C

Test done by _____

Date / Time _____

Delayed pressure urticaria

Testsite: Volar forearm (rod) or upper back (dermatographic tester)
Test: DPU test device, 15 minutes, diameter of applicator: 6.5 cm,
Reading times: ≈6 hours after testing
Threshold: Rod with lowest weight that results in angio-edema and erythema

kg	A	E
1		
2		
3		
4		
5		

Test done by _____

Date / Time _____

Solar urticaria

Testsite: Buttocks
Test: UVA / UVB irradiation (e.g. Saalman Multitester SBC LT 400)
Reading times: 10 minutes after testing
Threshold: Lowest dose of irradiation that results in wheal

UVA (J/cm ²)	W	UVB (mJ/cm ²)	W
2.4		24	
3.3		33	
4.2		42	
5.1		51	
6.0		60	

Test done by _____

Date / Time _____

Figure 1 Continued.

General recommendations for the management of CIndUs

Activation of skin mast cells with the release of histamine and other proinflammatory mediators leads to the signs and symptoms of CIndUs. In CSU, underlying causes of mast cell activation include autoreactivity (including functional autoantibodies), infectious diseases, and food or drug intolerance (2). In contrast, the underlying causes of CIndUs remain to be identified. As diagnostic measures do not reveal underlying causes or lead to specific therapeutic options, the diagnostic workup in CIndU should be limited to confirmation of the diagnosis and the assessment of disease activity by assessing trigger thresholds, where possible. The therapy should focus on the avoidance of the trigger factor and symptomatic treatment with the goal of reaching complete symptom control and of CIndU signs and symptoms.

Symptomatic treatment for CIndU targets mast cells, either by the inhibition of mast cell activation (e.g., omalizumab, cyclosporin) or by blocking mast cell mediators (e.g. H1 antihistamines, leukotriene receptor antagonists). As only very few studies on the treatment for most subtypes of CIndU have been performed in the last decades, symptomatic therapy schemes are often adopted from the study results and guideline recommendations for CSU (2). Interestingly, some CIndUs can be treated by desensitization to triggers.

This phenomenon has been described for cold urticaria (6, 7), heat urticaria (8), and solar urticaria (9). Although CIndU can present with a very chronic course (Table 2), with rare exceptions, CIndU patients experience spontaneous remission.

To identify effective treatment options for CIndUs, we performed a MEDLINE search and complemented the results by documenting additional published evidence known to us (Table 3). For our MEDLINE search (pubmed.com), the first search strategy was to search for the established terms for the CIndU subtypes combined with the limitation 'Controlled Clinical Trial'. The second search strategy was to search for the established terms for the CIndU subtypes combined with the term 'treatment'. The third search strategy was to search for the established terms combined with the individual terms for certain medical interventions, for example, 'PUVA', 'antihistamines', or 'cetirizine'. Only studies/reports on treatment approaches that are applicable and appropriate nowadays and which showed predominantly a benefit for the patients were included. Evidence levels (EL) assigned to treatment options on the basis of the evidence identified are A for double-blind controlled trials, B for case series with more than five patients per treatment option, and C for case reports and case series of five or less than five patients, and 0 for no published evidence (adopted from the GRADE, Grading of Recommendations, Assessment, Development and Evaluation, categorization of ELs). In addition,

Table 2 Definition, frequency, and duration of CIndUs

	Definition	Frequency*	Duration*
Symptomatic dermographism	Itching and/or burning skin and the development of strip-shaped wheals due to shear force acting on the skin	1–5% in the general population (10, 139–141)	6.5 years with a great variance (142–144)
Cold Urticaria	Itchy wheals or angioedema after cold exposure of the skin	Up to one-third of all PhysU cases (145)	4.8–7.9 years (27, 28, 32)
Heat Urticaria	Itchy wheals after heat exposure of the skin	Very rare, no data available	Very rare, no data available
Delayed Pressure Urticaria	Erythematous skin swelling after the application of sustained pressure	37% of patients with CSU (64) but rare as a primary inducible urticaria	6–9 years (142, 146, 147)
Solar urticaria	Itchy wheals that occur after light (UV and/or visible light) exposure	Rare in general population, 0.08% of patients with CSU (75), 18% of patients who consult a hospital because of sunlight-related skin problems (147)	3–6 years (148–150)
Vibratory angioedema	Cutaneous swellings immediately after exposure to vibration	Very rare, no data available	Very rare, no data available
Cholinergic Urticaria	Itchy wheals after active or passive warming	4–11.2% of population (151–153)	4–7.5 years (154, 155)
Aquagenic urticaria	Itchy wheals or angioedema after skin contact with water	Very rare, no data available	Very rare, no data available
Contact Urticaria	Itchy wheals or angioedema after contact with eliciting agent	Variable, depending on elicitor	Variable, depending on elicitor

*For most CIndUs, no reliable data on prevalence, incidence, and duration are available. The data presented are largely based on observational studies in small, preselected populations rather than from well-designed epidemiological studies.

Table 3 Evidence table for treatment options for CIndUs

	Double-blind controlled trials Evidence level A	Case series or uncontrolled studies with >5 patients Evidence level B	Case reports or small case series Evidence level C
Symptomatic dermographism	<p>Antihistamine:</p> <ul style="list-style-type: none"> - Acrivastine versus terfenadine in the treatment of symptomatic dermographism – a double-blind, placebo-controlled study. Boyle J, Marks P, Gibson JR. <i>J Int Med Res</i> 1989;17 Suppl 2:9B–13B. - Prevention of signs and symptoms of dermographic urticaria by single-dose ebastine 20 mg. Magerl M, Schmolke J, Metz M, Zuberbier T, Siebenhaar F, Maurer M. <i>Clin Exp Dermatol</i> 2009 Jul;34(5):e137–40 - The effect of cetirizine on symptoms and wealing in dermographic urticaria. Sharpe GR, Shuster S. <i>Br J Dermatol</i> 1993 Nov;129(5):580–3 - Effect of ketotifen in urticaria factitia and urticaria cholinergica in a crossover double-blind trial. Cap JP, Schwanitz HJ, Czarnetzki BM. <i>Hautarzt</i>. 1985 Sep;36(9):509–11 - Symptomatic dermographism: natural history, clinical features laboratory investigations and response to therapy. Breathnach SM, Allen R, Ward AM, Greaves MW. <i>Clin Exp Dermatol</i> 1983 Sep;8(5):463–76. 	<p>Antihistamine:</p> <ul style="list-style-type: none"> - The effect of H1 and H2 histamine antagonists on symptomatic dermographism. Matthews CN, Boss JM, Warin RP, Storari F. <i>Br J Dermatol</i> 1979 Jul;101(1):57–61. <p>Phototherapy:</p> <ul style="list-style-type: none"> - Narrowband ultraviolet B phototherapy is beneficial in antihistamine-resistant symptomatic dermographism: a pilot study. Borzova E, Rutherford A, Konstantinou GN, Leslie KS, Grattan CE. <i>J Am Acad Dermatol</i> 2008 Nov;59(5):752–7. - UVB treatment of factitious urticaria. Johnson M, Falk ES, Volden G. <i>Photodermatol</i> 1987 Dec;4(6):302–4. - The effect of psoralen photochemotherapy (PUVA) on symptomatic dermographism. Logan RA, O'Brien TJ, Greaves MW. <i>Clin Exp Dermatol</i> 1989 Jan;14(1):25–8. <p>Cyclosporin:</p> <ul style="list-style-type: none"> - Six cases of antihistamine-resistant dermographic urticaria treated with oral ciclosporin. Toda S, Takahagi S, Mihara S, Hide M. <i>Allergol Int</i> 2011 Dec;60(4):547–50 <p>Omaliizumab:</p> <ul style="list-style-type: none"> - Omaliizumab is an effective and rapidly acting therapy in difficult-to-treat chronic urticaria: a retrospective clinical analysis. Metz M., Ohanyan, T., Church, M. K., and Maurer, M. <i>J. Dermatol. Sci.</i> 2014; 73: 57–62 <p>Others:</p> <ul style="list-style-type: none"> - Efficacy of H₁ antihistamine, corticosteroids and cyclophosphamide in the treatment of chronic dermographic urticaria. Kumar R, Verma KK, Pasricha JS. <i>Indian J Dermatol Venereol Leprol</i> 2002 Mar-Apr;68 (2):88–91 	<p>Omaliizumab:</p> <ul style="list-style-type: none"> - Anti-immunoglobulin E treatment of patients with recalcitrant physical urticaria. Metz M, Altrichter S, Ardelean E, Kessler B, Krause K, Magerl M, Siebenhaar F, Weller K, Zuberbier T, Maurer M. <i>Int Arch Allergy Immunol</i> 2011;154(2):177–80 - Antihistamine-resistant urticaria factitia successfully treated with anti-immunoglobulin E therapy. Krause K, Ardelean E, Kessler B, Magerl M, Metz M, Siebenhaar F, Weller K, Worm M, Zuberbier T, Maurer M. <i>Allergy</i> 2010 Nov;65(11):1494–5 - Retreatment with omaliizumab results in rapid remission in chronic spontaneous and inducible urticaria. Metz M., Ohanyan, T., Church, M. K., and Maurer, M.: <i>JAMA Derm</i> 2014; 150: 288–290.

Table 3 (continued)

Cold urticaria	Double-blind controlled trials Evidence level A		Case series or uncontrolled studies with >5 patients Evidence level B		Case reports or small case series Evidence level C	
	Antihistamine:		Omalizumab:		Omalizumab:	
	<ul style="list-style-type: none"> - Rupatadine 20 mg and 40 mg are Effective in Reducing the Symptoms of Chronic Cold Urticaria. Abajian M, Curto-Barredo L, Krause K, Santamaria E, Izquierdo I, Church MK, Maurer M, Giménez-Arnau A. <i>Acta Derm Venereol</i> 2015 Jun 3 - Up-dosing with bilastine results in improved effectiveness in cold contact urticaria. Krause K, Spohr A, Zuberbier T, Church MK, Maurer M. <i>Allergy</i> 2013 Jul;68(7):921–8. - Critical temperature threshold measurement for cold urticaria: a randomized controlled trial of H(1)-antihistamine dose escalation. Magerl M, Pisarevskaja D, Staubach P, Martus P, Church MK, Maurer M. <i>Br J Dermatol</i> 2012 May;166(5):1095–9. - Rupatadine and its effects on symptom control, stimulation time, and temperature thresholds in patients with acquired cold urticaria. Metz M, Scholz E, Ferrán M, Izquierdo I, Giménez-Arnau A, Maurer M. <i>Ann Allergy Asthma Immunol</i> 2010 Jan;104(1):86–92 - High-dose desloratadine decreases wheal volume and improves cold provocation thresholds compared with standard-dose treatment in patients with acquired cold urticaria: a randomized, placebo-controlled, crossover study. Siebenhaar F, Degener F, Zuberbier T, Martus P, Maurer M. <i>J Allergy Clin Immunol</i> 2009 Mar;123(3):672–9. - Acquired cold urticaria symptoms can be safely prevented by ebastine. Magerl M, Schmolke J, Siebenhaar F, Zuberbier T, Metz M, Maurer M. <i>Allergy</i> 2007 Dec;62(12):1465–8. 		<ul style="list-style-type: none"> - Real-life experiences with omalizumab for the treatment of chronic urticaria. Sussman G, Hébert J, Barron C, Bian J, Caron-Guay RM, Lafamme S, Stern S. <i>Ann Allergy Asthma Immunol</i> 2014 Feb;112(2):170–4 - Omalizumab is an effective and rapidly acting therapy in difficult-to-treat chronic urticaria: a retrospective clinical analysis. Metz M., Ohanyan, T., Church, M. K., and Maurer, M. <i>J. Dermatol. Sci.</i> 2014; 73: 57–62 		<ul style="list-style-type: none"> - Effective treatment of idiopathic chronic cold urticaria with omalizumab: report of 3 cases. Le Moing A, Bécourt C, Pape E, Dejobert Y, Delaporte E, Staumont-Sallé D. <i>J Am Acad Dermatol</i> 2013 Aug;69(2):e99–101 - Treatment of severe cold contact urticaria with omalizumab: case reports. Brodská P, Schmid-Grendelmeier P. <i>Case Rep Dermatol</i> 2012 Sep;4(3):275–8 - Anti-immunoglobulin E treatment of patients with recalcitrant physical urticaria. Metz M, Altrichter S, Ardelean E, Kessler B, Krause K, Magerl M, Siebenhaar F, Weller K, Zuberbier T, Maurer M. <i>Int Arch Allergy Immunol</i> 2011;154(2):177–80 - Successful treatment of cold-induced urticaria/anaphylaxis with anti-IgE. Boyce JA. <i>J Allergy Clin Immunol</i>. 2006 Jun;117(6):1415–8 	<p>Cyclosporin:</p> <ul style="list-style-type: none"> - Cold urticaria responding to systemic ciclosporin. Marsland AM, Beck MH. <i>Br J Dermatol</i> 2003 Jul;149(1):214–5 <p>Others:</p> <ul style="list-style-type: none"> - Danazol in the treatment of refractory acquired cold urticaria. McDonald SK, Thai KE. <i>Australas J Dermatol</i> 2014 Nov;55(4):303–4 - Successful treatment of systemic cold contact urticaria with etanercept in a patient with psoriasis. Gualdi G, Monari P, Rossi MT, Crotti S, Calzavara-Pinton PG. <i>Br J Dermatol</i> 2012 Jun;166(6):1373 - Treatment of acquired cold urticaria with cetirizine and zafirlukast in combination. Bonadonna P, Lombardi C, Senna G, Canonica GW, Passalacqua G. <i>J Am Acad Dermatol</i> 2003 Oct;49(4):714–6.

Table 3 (continued)

	Double-blind controlled trials Evidence level A	Case series or uncontrolled studies with >5 patients Evidence level B	Case reports or small case series Evidence level C
Heat urticaria	<p>- Mizolastine in primary acquired cold urticaria. Dubertret L, Pecquet C, Murrieta-Aguttes M, Leynadier F. <i>J Am Acad Dermatol</i> 2003 Apr; 48(4):578–83.</p> <p>- Comparison of the new antihistamine acrivastine (BW 825C) versus cyproheptadine in the treatment of idiopathic cold urticaria. Neittaanmäki H, Fräki JE, Gibson JR. <i>Dermatologica</i> 1988; 177(2):98–103.</p> <p>- Comparison of cinnarizine, cyproheptadine, doxepin, and hydroxyzine in treatment of idiopathic cold urticaria: usefulness of doxepin. Neittaanmäki H, Myöhänen T, Fräki JE. <i>J Am Acad Dermatol</i> 1984 Sep; 11(3):483–9.</p> <p>- Effect of ketotifen treatment on cold-induced urticaria. St-Pierre JP, Kobric M, Rackham A. <i>Ann Allergy</i> 1985 Dec; 55(6):840–3.</p> <p>- Primary acquired cold urticaria. Double-blind comparative study of treatment with cyproheptadine, chlorpheniramine, and placebo. Wanderer AA, St Pierre JP, Ellis EF. <i>Arch Dermatol</i> 1977 Oct; 113(10):1375–7.</p>	<p>None</p> <p>None</p>	<p>- Treatment of acquired cold urticaria with rupatadine. Di Leo E, Nettis E, Cassano N, Foti C, Delle Donne P, Vena GA, Vacca A. <i>Allergy</i> 2009 Sep; 64(9):1387–8</p> <p>- Complete remission of severe idiopathic cold urticaria on interleukin-1 receptor antagonist (anakinra). Bodar EJ, Simon A, de Visser M, van der Meer JW. <i>Neth J Med</i> 2009 Oct; 67(9):302–5.</p> <p>- Use of anakinra (Kineret) in the treatment of familial cold autoinflammatory syndrome with a 16-month follow-up. Ross JB, Finlayson LA, Klotz PJ, Langley RG, Gaudet R, Thompson K, Churchman SM, McDermott MF, Hawkins PN. <i>J Cutan Med Surg</i> 2008 Jan-Feb; 12(1):8–16.</p> <p>Desensitization:</p> <p>- A case study on the induction of clinical tolerance in cold urticaria. Keahey TM, Indrisano J, Kainer MA. <i>J Allergy Clin Immunol</i> 1988 Aug; 82(2):256–61.</p> <p>- Cold urticaria treated by induction of tolerance. Black AK, Sibbald RG, Greaves MW. <i>Lancet</i> 1979 Nov 3; 2(8149):964.</p> <p>- Induced tolerance in cold urticaria caused by cold-evoked histamine release. Bentley-Phillips CB, Black AK, Greaves MW. <i>Lancet</i> 1976 Jul 10; 2(7976):63–6.</p> <p>Antihistamine:</p> <p>- Localized heat urticaria in a child. Tomi NS, Schuster C, Bechara F, Hoffmann K, Kränke B. <i>J Eur Acad Dermatol Venerol</i> 2008 Mar; 22(3):384–6</p> <p>- Mediator release in local heat urticaria: protection with combined H1 and H2 antagonists. Irwin RB, Lieberman P, Friedman MM, Kainer M, Kaplan R, Bale G, Treadwell G, Yoo TJ. <i>J Allergy Clin Immunol</i> 1985 Jul; 76(1):35–9.</p>

Table 3 (continued)

Delayed pressure urticaria	Double-blind controlled trials Evidence level A	Case series or uncontrolled studies with >5 patients Evidence level B	Case reports or small case series Evidence level C
	<p>Antihistamine and/or Leukotriene antagonist:</p> <ul style="list-style-type: none"> - Desloratadine in combination with montelukast suppresses the dermographometer challenge test papule, and is effective in the treatment of delayed pressure urticaria: a randomized, double-blind, placebo-controlled study. Nettis E, Colanardi MC, Soccio AL, Ferrannini A, Vacca A. <i>Br J Dermatol</i> 2006 Dec;155(6):1279–82. - Efficacy of montelukast, in combination with loratadine, in the treatment of delayed pressure urticaria. Nettis E, Pannofino A, Cavallo E, Ferrannini A, Tursi A. <i>J Allergy Clin Immunol</i> 2003 Jul;112(1):212–3 - Comparison of oxatomide and clemastine in the treatment of chronic urticaria. A double blind study. Beck HL, Cramers M, Herlin T, Søndergaard I, Zachariae H. <i>Dermatologica</i> 1985;171(1):49–51. 	<p>Omaliuzumab</p> <ul style="list-style-type: none"> - Omaliuzumab is an effective and rapidly acting therapy in difficult-to-treat chronic urticaria: a retrospective clinical analysis. Metz M., Ohanyan T., Church M. K., and Maurer M. <i>J. Dermatol. Sci.</i> 2014; 73: 57–62 <p>Others:</p> <ul style="list-style-type: none"> - Delayed pressure urticaria: response to treatment with sulfasalazine in a case series of seventeen patients. Swerlick RA, Puhar N. <i>Dermatol Ther</i> 2015 - Theophylline as “add-on” therapy in patients with delayed pressure urticaria: a prospective self-controlled study. Kalogeromitros D, Kempuraj D, Katsarou-Katsari A, Gregoriou S, Makris M, Boucher W, Theoharides TC. <i>Int J Immunopathol Pharmacol</i> 2005 Jul-Sep;18(3):595–602. - Delayed pressure urticaria – dapsona heading for first-line therapy? Grundmann SA, Kiefer S, Luger TA, Brehler R. <i>J Dtsch Dermatol Ges</i> 2011 Nov;9(11):908–12 	<p>Omaliuzumab:</p> <ul style="list-style-type: none"> - Omaliuzumab treatment in 2 cases of refractory heat urticaria. Carballeda F, Nuñez R, Martín-Lazaro J, Juárez Y, Castiñeira I, Carballeda F, Nuñez R, Martín-Lazaro J, Juárez Y, Castiñeira I, Fernández L, Boquete M. <i>J Investig Allergol Clin Immunol</i> 2013; 23(7):519–21 - Effective treatment of refractory severe heat urticaria with omaliuzumab. Bullerkotte U, Wieczorek D, Kapp A, Wedi B. <i>Allergy</i> 2010 Jul;65(7):931–2. <p>Omaliuzumab:</p> <ul style="list-style-type: none"> - Successful treatment of severe delayed pressure angio-oedema with omaliuzumab. Rodríguez-Rodríguez M, Antolin-Amerigo D, Barbaroja-Escudero J, Sánchez-González MJ, Alvarez-Mon M. <i>Allergol Immunopathol (Madrid)</i> 2014 Jan-Feb;42(1): 78–80 - Anti-immunoglobulin E treatment of patients with recalcitrant physical urticaria. Metz M, Altrichter S, Ardelean E, Keßler B, Krause K, Magerl M, Siebenhaar F, Weller K, Zuberbier T, Maurer M. <i>Int Arch Allergy Immunol</i> 2011;154(2):177–80 - Efficacy of omaliuzumab in delayed pressure urticaria: a case report. Bindsløv-Jensen C, Skov PS. <i>Allergy</i> 2010 Jan;65(1):138–9 <p>Others:</p> <ul style="list-style-type: none"> - Class action of oral coumarins in the treatment of a patient with chronic spontaneous urticaria and delayed-pressure urticaria. Samarasinghe V, Marsland AM. <i>Clin Exp Dermatol</i> 2012 Oct;37(7):741–3 - Positive impact of chloroquine on delayed pressure urticaria.

Table 3 (continued)

	Double-blind controlled trials Evidence level A	Case series or uncontrolled studies with >5 patients Evidence level B	Case reports or small case series Evidence level C
Solar urticaria	<p>Antihistamine:</p> <ul style="list-style-type: none">- A comparison of cetirizine and tefenadine in the management of solar urticaria. Bilisland D, Ferguson J. <i>Photodermatol Photoimmunol Photomed</i> 1991 Apr;8(2):62–4.	<p>Antihistamine:</p> <ul style="list-style-type: none">- Cetirizine for solar urticaria in the visible spectrum. Monfrecola G, Masturzo E, Riccardo AM, Del Sorbo A. <i>Dermatology</i> 2000;200(4):334–5 <p>Combinations:</p> <ul style="list-style-type: none">- Synergistic effect of broad-spectrum sunscreens and antihistamines in the control of idiopathic solar urticaria. Faurschou A, Wulf HC. <i>Arch Dermatol</i> 2008 Jun;144(6):765- Treatment of solar urticaria using antihistamine and leukotriene receptor antagonist combinations alloted to disease severity. Levi A, Enk CD. <i>Photodermatol Photoimmunol Photomed</i> 2015 Jun 6	<p>Kulthanan K, Thumpimukvatana N. <i>J Drugs Dermatol</i> 2007 Apr;6(4):445–6.</p> <ul style="list-style-type: none">- Successful treatment of delayed pressure urticaria with anti-TNF-alpha. Magerl M, Philipp S, Manasterski M, Friedrich M, Maurer M. <i>J Allergy Clin Immunol</i> 2007 Mar;119(3):752–4- Delayed pressure urticaria controlled by tranexamic acid. Shedden C, Highet AS. <i>Clin Exp Dermatol</i> 2006 Mar;31(2):295–6- Successful treatment of delayed pressure urticaria with montelukast. Berkun Y, Shalit M. <i>Allergy</i> 2000 Feb;55(2):203–4- Chronic sulfasalazine therapy in the treatment of delayed pressure urticaria and angioedema. Engler RJ, Squire E, Benson P. <i>Ann Allergy Asthma Immunol</i> 1995 Feb;74(2):155–9. <p>Phototherapy:</p> <ul style="list-style-type: none">- UVA rush hardening for the treatment of solar urticaria. Beissert S, Ständer H, Schwarz T. <i>J Am Acad Dermatol</i> 2000 Jun;42(6):1030–2.- Solar urticaria: long-term rush hardening by inhibition spectrum narrow-band UVB 311 nm. Wolf R, Herzinger T, Grahovac M, Prinz JC. <i>Clin Exp Dermatol</i> 2013 Jun;38(4):446–7- Successful and long-lasting treatment of solar urticaria with ultraviolet A rush hardening therapy. Masuoka E, Fukunaga A, Kishigami K, Jimbo H, Nishioka M, Uchimura Y, Taguchi K, Ohgou N, Nishigori C.

Table 3 (continued)

Double-blind controlled trials Evidence level A	Case series or uncontrolled studies with >5 patients Evidence level B	Case reports or small case series Evidence level C
	<p>Phototherapy:</p> <ul style="list-style-type: none"> - UVB phototherapy and photochemotherapy (PUVA) in the treatment of polymorphic light eruption and solar urticaria. Addo HA, Sharma SC. <i>Br J Dermatol</i> 1987 Apr;116(4):539–47. <p>Immunoglobulins:</p> <ul style="list-style-type: none"> - Severe and refractory solar urticaria treated with intravenous immunoglobulins: a phase II multicenter study. Aubin F, Porcher R, Jeanmougin M, Léonard F, Bedane C, Moreau A, Schmutz JL, Marguery MC, Adamski H, Viguiet M; Société Française de Photodermatologie. <i>J Am Acad Dermatol</i> 2014 Nov;71(5):948–953 - Solar urticaria treated with intravenous immunoglobulins. Adamski H, Bedane C, Bonneville A, Thomas P, Peyron JL, Rouchouse B, Cambazard F, Jeanmougin M, Viguiet M. <i>J Am Acad Dermatol</i> 2011 Aug;65(2):336–40 - Solar urticaria successfully treated with intravenous immunoglobulins. Maksimovic L, Frémont G, Jeanmougin M, Dubertret L, Viguiet M. <i>Dermatology</i> 2009; 218(3):252 <p>Others:</p> <ul style="list-style-type: none"> - Systemic photoprotection in solar urticaria with α-melanocyte-stimulating hormone analogue INle4-D-Phe7I-α-MSH. Haylett AK, Nie Z, Brownrigg M, Taylor R, Rhodes LE. <i>Br J Dermatol</i> 2011 Feb;164(2):407–14 	<p><i>Br J Dermatol</i> 2012 Jul;167(1):198–201</p> <ul style="list-style-type: none"> - Successful treatment of solar urticaria by extracorporeal photochemotherapy (photopheresis) – a case report. Mang R, Stege H, Budde MA, Ruzicka T, Krutmann J. <i>Photodermatol Photoimmunol Photomed</i> 2002 Aug;18(4):196–8. - Prolonged benefit following ultraviolet A phototherapy for solar urticaria. Dawe RS, Ferguson J. <i>Br J Dermatol</i> 1997 Jul;137(1):144–8. <p>Antihistamine:</p> <ul style="list-style-type: none"> - Treatment of solar urticaria with terfenadine. Bernhard JD. <i>J Am Acad Dermatol</i> 1993 Apr;28(4):668 - Solar urticaria in the visible spectrum successfully treated with astemizole. Monfrecola G, Nappa P, Pini D. <i>Dermatologica</i> 1990; 180(3):154–6 - Solar urticaria: treatment with terfenadine. Rajatanavin N, Bernhard JD. <i>J Am Acad Dermatol</i> 1988 Mar;18(3):574 - Treatment of solar urticaria with terfenadine. Diffey BL, Farr PM. <i>Photodermatol</i>. 1988 Feb;5(1):25–9 - Solar urticaria: a case with good therapeutic response to cimetidine. Tokura Y, Takigawa M, Yamauchi T, Yamada M. <i>Dermatologica</i> 1986; 173(5):224–8. - Antihistamine combination treatment for solar urticaria. Grundmann SA, Ständer S, Luger TA, Beissert S. <i>Br J Dermatol</i> 2008 Jun;158(6):1384–6 <p>Omalizumab:</p> <ul style="list-style-type: none"> - Treatment with omalizumab in a 16-year-old Caucasian girl with refractory solar urticaria. Arasi S, Crisafulli G, Caminiti L, Guarnieri F, Aversa T, Porcaro F, Pajno GB. <i>Pediatr Allergy Immunol</i> 2015 Sep;26(6):583–5 - Three cases of solar urticaria successfully treated with omalizumab. Balu-Piqué C, Aguilera Peiró P. <i>J Eur Acad Dermatol Venerol</i> 2015 Jan 30

Table 3 (continued)

Double-blind controlled trials Evidence level A	Case series or uncontrolled studies with >5 patients Evidence level B	Case reports or small case series Evidence level C
		<ul style="list-style-type: none"> - Omalizumab is an effective and rapidly acting therapy in difficult-to-treat chronic urticaria: a retrospective clinical analysis. Metz, M., Ohanyan, T., Church, M. K., and Maurer, M. <i>J. Dermatol. Sci.</i> 2014; 73: 57–62 - Successful omalizumab treatment of severe solar urticaria in a 6-year-old child. Levi A, Tal Y, Dranitzki Z, Shalit M, Enk CD. <i>Pediatr Allergy Immunol.</i> 2015 Sep;26(6):588–90 - Successful treatment of solar urticaria with anti-immunoglobulin E therapy. Güzelbey O, Ardelean E, Magerl M, Zuberbier T, Maurer M, Metz M. <i>Allergy</i> 2008 Nov;63(11):1563–5 <p>Others:</p> <ul style="list-style-type: none"> - Treatment of refractory solar urticaria with plasma exchange. Bissonnette R, Buskard N, McLean DJ, Lui H. <i>J Cutan Med Surg</i> 1999 Jul;3(5):236–8. - Solar urticaria – effective treatment by plasmapheresis. Duschet P, Leyen P, Schwarz T, Höcker P, Greiter J, Gschnait F. <i>Clin Exp Dermatol</i> 1987 May;12(3):185–8 - Cyclosporin A therapy for severe solar urticaria. Edström DW, Ros AM. <i>Photodermatol Photoimmunol Photomed</i> 1997 Feb-Apr;13(1-2):61–3. - Cyclosporin A therapy for severe solar urticaria. Edström DW, Ros AM. <i>Photodermatol Photoimmunol Photomed</i> 1997 Feb-Apr;13(1-2):61–3. <p>Antihistamine:</p> <ul style="list-style-type: none"> - Failure of omalizumab and successful control with ketotifen in a patient with vibratory angio-oedema. Pressler A, Grosber M, Halle M, Ring J, Brockow K. <i>Clin Exp Dermatol</i> 2013 Mar;38(2):151–3 - Vibratory angioedema: lesion induction, clinical features, laboratory and ultrastructural findings and response to therapy. Lawlor F, Black AK, Breathnach AS, Greaves MW. <i>Br J Dermatol</i> 1989 Jan;120(1):93–9.
Vibratory angioedema	None	None

Table 3 (continued)

	Double-blind controlled trials Evidence level A	Case series or uncontrolled studies with >5 patients Evidence level B	Case reports or small case series Evidence level C
Cholinergic urticaria	<p>Antihistamine:</p> <ul style="list-style-type: none"> - Double-blind crossover study of high-dose cetirizine in cholinergic urticaria. Zuberbier T, Münzberger C, Hausteim U, Trippas E, Burtin B, Mariz SD, Henz BM. <i>Dermatology</i> 1996;193(4):324–7. - Efficacy of cetirizine in cholinergic urticaria. Zuberbier T, Aberer W, Burtin B, Rihoux JP, Czarnetzki BM. <i>Acta Derm Venereol</i> 1995 Mar;75(2):147–9. - Acrivastine versus hydroxyzine in the treatment of cholinergic urticaria. A placebo-controlled study. Kobza Black A, Aboobaker J, Gibson JR, Harvey SG, Marks P. <i>Acta Derm Venereol</i> 1988;68(6):541–4. - Effect of ketotifen in urticaria factitia and urticaria cholinergica in a crossover double-blind trial. Cap JP, Schwanitz HJ, Czarnetzki BM. <i>Hautarzt</i> 1985 Sep;36(9):509–11 <p>Combination of H1 and H2 antihistamine:</p> <p>Evaluation of different combined regimens in the treatment of cholinergic urticaria. Alsamrai AM, Hasan AA, Alobaidi AH. <i>World Allergy Organ J</i> 2012 Aug;5(8):88–93</p> <p>Others:</p> <ul style="list-style-type: none"> - Beneficial effects of danazol on symptoms and laboratory changes in cholinergic urticaria. Wong E, Effekhari N, Greaves MW, Ward AM. <i>Br J Dermatol</i> 1987 Apr;116(4):553–6. 	<p>Desensitization:</p> <ul style="list-style-type: none"> - Rapid desensitization with autologous sweat in cholinergic urticaria. Kozaru T, Fukunaga A, Taguchi K, Ogura K, Nagano T, Oka M, Horikawa T, Nishigori C. <i>Allergol Int</i> 2011 Sep;60(3):277–81 <p>Omalizumab:</p> <ul style="list-style-type: none"> - Omalizumab is an effective and rapidly acting therapy in difficult-to-treat chronic urticaria: a retrospective clinical analysis. Metz M, Ohanyan T, Church MK, Maurer M. <i>J Dermatol Sci</i> 2014 Jan;73(1):57–6 	<p>Others:</p> <ul style="list-style-type: none"> - Amitriptyline and bromazepam in the treatment of vibratory angioedema: which role for neuroinflammation? Guarneri F, Guarneri C, Marini HR. <i>Dermatol Ther</i> 2014 Nov-Dec;27(6):361–4. <p>Methanthelinumbromide:</p> <ul style="list-style-type: none"> - Successful treatment of cholinergic urticaria with methanthelinumbromide. Altrichter S, Wosny K, Maurer M. <i>J Dermatol</i> 2015 Apr;42(4):422–4 <p>Botulinum toxin</p> <ul style="list-style-type: none"> - Cholinergic urticaria responding to botulinum toxin injection for axillary hyperhidrosis. Sheraz A, Halpern S. <i>Br J Dermatol</i> 2013 Jun;168(6):1369–70 <p>Surgical:</p> <ul style="list-style-type: none"> - Efficacy of stellate ganglion block in cholinergic urticaria with acquired generalized hypohidrosis. Shin JH, Kim do W, Yang JY, Lee WI. <i>Korean J Pain</i> 2012 Oct;25(4):278–80 <p>Omalizumab:</p> <ul style="list-style-type: none"> - Successful treatment of cholinergic urticaria with anti-immunoglobulin E therapy. Metz M, Bergmann P, Zuberbier T, Maurer M. <i>Allergy</i> 2008 Feb;63(2):247–9 <p>Danazol:</p> <ul style="list-style-type: none"> - Severe refractory cholinergic urticaria treated with danazol. La Shell MS, England RW. <i>J Drugs Dermatol</i> 2006 Jul-Aug;5(7):664–7. - Cholinergic pruritus, erythema and urticaria: a disease spectrum responding to danazol. Berth-Jones J, Graham-Brown RA. <i>Br J Dermatol</i> 1989 Aug;121(2):235–7. <p>Ketotifen:</p> <ul style="list-style-type: none"> - Refractory cholinergic urticaria successfully treated with ketotifen. McClean SP, Arreaza EE, Lett-Brown MA, Grant JA. <i>J Allergy Clin Immunol</i> 1989 Apr;83(4):738–41

Table 3 (continued)

	Double-blind controlled trials Evidence level A	Case series or uncontrolled studies with >5 patients Evidence level B	Case reports or small case series Evidence level C
			<p>Others:</p> <ul style="list-style-type: none"> - Severe cholinergic urticaria successfully treated with scopolamine butylbromide in addition to antihistamines. Ujjie H, Shimizu T, Natsuga K, Arita K, Tomizawa K, Shimizu H. <i>Clin Exp Dermatol</i> 2006 Jul;31(4):588–9 - Beta blocker therapy in cholinergic urticaria. Ammann P, Surber E, Bertel O. <i>Am J Med</i> 1999 Aug;107(2):191 - Successful treatment of disabling cholinergic urticaria. Feinberg JH, Toner CB. <i>Mil Med</i>. 2008 Feb;173(2):217–20. <p>UV in combination with antihistamines:</p> <ul style="list-style-type: none"> - Treatment of aquagenic urticaria with PUVA and astemizole. Martínez-Escribano JA, Quecedo E, De la Cuadra J, Frías J, Sánchez-Pedreño P, Aliaga A. <i>J Am Acad Dermatol</i> 1997 Jan;36(1):118–9. <p>- Aquagenic urticaria.</p> <p>Parker RK, Crowe MJ, Guin JD. <i>Cutis</i> 1992 Oct;50(4):283–4.</p> <p>Antihistamine:</p> <ul style="list-style-type: none"> - Aquagenic urticaria in 2 adolescents. Yavuz ST, Sahiner UM, Tuncer A, Sackesen C. <i>J Investig Allergol Clin Immunol</i> 2010;20(7):624–5. <p>Aquagenic urticaria: a report of two cases.</p> <p>Park H, Kim HS, Yoo DS, Kim JW, Kim CW, Kim SS, Hwang JI, Lee JY, Choi YJ. <i>Ann Dermatol</i> 2011 Dec;23(Suppl 3):S371–4</p> <p>Barrier cream:</p> <ul style="list-style-type: none"> - Localized aquagenic urticaria: efficacy of a barrier cream. Bayle P, Gadroy A, Messer L, Bazex J. <i>Contact Dermatitis</i>. 2003 Sep;49(3):160–1 <p>Not applicable</p>
Aquagenic urticaria	None	None	
Contact urticaria	Not applicable	Not applicable	

we designated selected treatment options as 'recommended best practice', based on our clinical experience.

Neither the assignment of evidence levels nor the given recommendations reflect the licensed indications of the drugs, but solely the medical literature and the author's clinical experience. With the exception of some antihistaminic drugs, most of the named treatment options in this manuscript are off label in most countries.

Symptomatic dermographism

Symptomatic dermographism (SD, Syn. urticaria factitia, dermographic urticaria), the most common physical urticaria (Table 2), is characterized by itching and/or burning skin and the development of itchy wheals (and in rare cases angioedema) due to shearing forces on the skin, which may be brought about during rubbing, scratching, or scrubbing (Table 2). SD should be differentiated from simple dermographism, where whealing, but not pruritus, occurs after firm stroking of the skin (10–12). Other types of dermographism such as white dermographism (in atopic patients) are unrelated to SD.

For the diagnosis of SD, a smooth blunt object (closed ball pen or a wooden spatula) should be held perpendicular to the skin and used to apply a light stroking pressure on the volar forearm or upper back. The skin at the test site should be unbroken and free of obvious signs of infection or inflammation. A response is considered positive if a pruritic palpable wheal is present within 10 min of provocation. A wheal response without itch indicates simple dermographism (a common physiological variant).

A calibrated dermographometer is commercially available (HTZ Limited, New Addington, UK). It has a spring-loaded smooth steel tip of 2.3 mm in diameter. The pressure on the tip can be varied by turning a furled head at the top of the instrument. The scale settings from 0 to 15 are equivalent to a range of tip pressures from approximately 20–160 g/mm² (196–1569 kPa). The tool needs to be calibrated before its use in the clinical setting to adjust the applied pressure to the desired values. The development of a pruritic palpable wheal to applied pressure of <36 g/mm² is considered diagnostic of symptomatic dermographism. The tool's adjustability allows for determining the patient's trigger threshold (10, 13). Recently, a simplified dermographic tester was developed (14). This instrument (FricTest®; Moxie, Berlin, Germany) consists of a disinfestable plastic comb with four tips (which are 3.0, 3.5, 4.0, and 4.5 mm in length, respectively), which apply graded shearing forces to the skin, thus allowing for the determination of the trigger threshold. Each tip is 3 mm in diameter and has a slightly rounded end to minimize traumatization of the skin. To obtain a response, the instrument is placed vertically so that the tips are touching the skin, and then stroked once from across the width of the volar surface of the forearm for a distance of approximately 60 mm. A response to dermographic testing is considered positive if a pruritic palpable wheal of ≥3 mm width is present within 10 min of provocation.

In addition to trigger avoidance, the first-line therapy for SD is a nonsedating second-generation H1 antihistamine at the licensed dose (evidence level A, recommended best practice). In patients who do not obtain complete control with this treatment, increasing the dose up to four times is recommended (evidence level 0, recommended best practice) (2, 15, 16). Although there is a lack of good evidence, the latter recommendation was assigned to be second line due to its excellent side-effect profile, low costs, and good efficacy experiences by the authors. Third-line treatment options include omalizumab (evidence level B, recommended best practice) (2, 17, 18) and cyclosporin (evidence level B) (19). Phototherapy and photochemotherapy (evidence level B) have also been reported to be effective (20–24).

Cold urticaria

Cold urticaria (ColdU, Syn. acquired cold urticaria or cold contact urticaria) is defined by the appearance of wheals after contact cooling and rewarming of the skin (Table 1) (12, 25, 26). ColdU is the second most common form of physical urticaria. Its estimated annual incidence is 0.05% (27). ColdU often develops in young adults. Women show a slightly higher prevalence (28). Symptoms typically occur within minutes after skin contact with cold air, liquids, or solid objects and persist for an hour (25, 29, 30). Severe cases may show systemic involvement including anaphylaxis (31). ColdU is often of long disease duration, reportedly 4.8–7.9 years (27, 28, 32).

Provocation tests should be performed by applying a cold stimulus to forearm skin. Cold provocation methods include the traditional ice cube test, testing with cool packs or cold water baths, and TempTest® measurements (Fig. 1). If an ice cube is used for testing, it should be melting within a thin plastic bag to avoid cold damage of the skin and to prevent direct water contact to avoid the confusion with aquagenic urticaria if the test is positive (33). The use of cold water baths requires special care, because this method carries a risk of inducing systemic reactions. TempTest® is a Peltier element-based provocation device. The TempTest® 4.0 model (Courage & Khazaka, Köln, Germany) has a single Peltier element (length: 350 mm, width: 2 mm) that provides a continuous temperature gradient along its length (from 4 to 44°C) (34). The use of TempTest® allows for reproducible and standardized cold (and heat) provocation tests and the identification of temperature and stimulation time thresholds (34, 35). Cold provocation testing should be performed for 5 min. In some patients, shorter or longer provocation times may be appropriate, for example, 30 s (in patients who are very sensitive and/or afraid of massive reactions) or up to 20 min (in patients with a positive history, but no wheal after standard testing) (32, 36, 37). Alternative test methods may be required in patients with a negative ice cube test; for example, an arm can be immersed in cold water at 5–10°C for 10 min. Test sites should be inspected and test responses should be assessed 10 min after the end of provocation testing. The test should be considered positive if the test site shows a palpable and clearly visible wheal and flare-type skin

reaction. This reaction is, in most cases, associated with itch and/or a burning sensation.

In patients who show a positive test reaction, threshold testing should be performed if possible. Threshold testing is carried out to determine the stimulation time threshold or the temperature threshold. The stimulation time threshold (32) is the shortest duration of cold exposure sufficient to induce a positive test reaction. Stimulation time thresholds are determined by varying the time of cold application needed to induce a wheal and flare-type skin response. Stimulation time threshold tests can be carried out with an ice cube or TempTest® (Fig. 1). Ice cube stimulation time thresholds of ≤ 3 min are associated with higher disease activity (32). The temperature threshold of ColdU patients, that is, the highest temperature sufficient to induce a positive test reaction, can be assessed with TempTest®, but not by ice cube testing. Temperature thresholds should be determined whenever TempTest® is available, as this information can help patients to avoid risky situations in their daily lives. Temperature threshold measurements are useful for assessing disease severity and activity as well as the efficacy of therapy (38).

The underlying causes of ColdU are currently unknown. Targeted causal treatment is therefore not possible. Antibiotic treatment with doxycycline or penicillin for several weeks can induce remission in some patients (27, 39). All patients need to be counseled to avoid a prolonged skin contact with objects that are below their threshold temperatures.

The first-line symptomatic treatment is a nonsedating H1 antihistamine (evidence level A, best practice recommendation). This recommendation is supported by several controlled studies (40–42). In many patients, however, a standard dose of antihistamine does not provide complete protection, even when used every day. High doses of H1 antihistamines are more effective in ColdU than standard doses (43–47) and should be tried in patients who do not respond to a standard dose of antihistamine (evidence level A, best practice recommendation). Treatment options for antihistamine-resistant ColdU patients include omalizumab treatment (evidence level B, best practice recommendation) (18, 48–50), antibiotic treatment (evidence level B) (27), and cold desensitization (evidence level B) (6, 7, 51). Desensitization, that is the reduction in skin sensitivity to cold by repeated cold exposure, has been reported to protect from symptom development. However, this treatment can induce anaphylactic shock during induction and should therefore only be performed under expert physician supervision (51), and maintenance of tolerance requires daily cold showers. The compliance to proceed with the therapy in a home setting is poor (52). Anakinra (anti-IL-1) and etanercept (TNF inhibitor) reportedly showed beneficial responses in selected cases (evidence level C) (53, 54).

Heat urticaria

Heat urticaria (Syn. heat contact urticaria) is an exceptionally rare physical urticaria defined by the appearance of

wheals after contact heating of the skin within minutes of exposure (Table 1) (55, 56). Heat urticaria must be differentiated from cholinergic urticaria and from solar urticaria. Provocation testing should be performed by applying a hot stimulus to the skin of the volar forearm. Heat provocation methods that can be used for skin testing include testing with metal/glass cylinders filled with hot water, hot water baths, or TempTest® measurements (Fig. 1). Heat should be applied for 5 min at temperatures of up to 44°C. In some patients, shorter or longer provocation times and higher temperatures may be appropriate. Test sites should be inspected and test responses should be assessed 10 min after provocation testing. The test is considered positive if the test site shows a palpable and clearly visible wheal and flare-type skin reaction. This reaction is, in most cases, accompanied by itch and/or associated with a burning sensation. In patients who show a positive test reaction, stimulation time and/or temperature thresholds should be determined. This helps to determine the disease activity and to assessing the response to therapy. Treatment options for heat urticaria are limited. Nonsedating antihistamines, alone or in combination with an H2 blocker, have been reported to be effective (evidence level C, best practice recommendation) (57, 58). Some case reports suggest that omalizumab may be beneficial in difficult-to-treat patients (evidence level C, best practice recommendation) (59, 60).

Delayed pressure urticaria

Delayed pressure urticaria (DPU) is defined by the appearance of a skin swelling response after the application of a sustained pressure stimulus to the skin (Table 1) (61–63). Like other CIndUs, DPU may occur with other forms of chronic urticaria, including spontaneous disease (64). Responses occur between 30 min and 12 h (usually 6–8 h) after exposure to pressure and may last up to 72 h. The principle of testing is the application of a sustained pressure to the skin. Test methods include the suspension of weights over the shoulder (7 kg on a 3-cm shoulder strap), the application of rods, lowered vertically onto the skin and supported in a frame, on the back, the thigh, or the forearm, and the use of a dermatographometer. The latter two methods allow for reproducible measurements and the assessment of thresholds.

In the literature, the use of many different rod diameters and weights (with a wide range of pressures applied to the patient) is reported. Lawlor and coworkers, for example, used a rod of 1.5 cm diameter with weights of 2.29 kg (127 kPa) to 4.79 kg (266 kPa) for up to 15 min on the back (62). Barlow used rods that were 1.5 cm in diameter and weights of 2.5 kg (139 kPa) and 3.5 kg (194 kPa) resting on the anterior thighs for 20 min (64). The 5-kg rod used at the Charité Hospital on the patient's forearms for 15 min measures 5.5 cm in diameter (20.7 kPa). When testing with the dermatographometer, the device should be applied perpendicularly at 100 g/mm² (981 kPa) for 70 seconds on the upper back.

The test should be considered positive if the test site shows a delayed red palpable swelling. Test sites should be

inspected and test responses should be assessed (by the patient or physician) approximately 6 h after the end of provocation testing. The reaction is not usually associated with pruritus, but may be accompanied by a burning/painful sensation. DPU must be differentiated from symptomatic dermographism, which is immediate. Threshold testing should be performed in patients who show a positive test reaction. Threshold testing may allow the physician to assess disease activity and treatment responses.

DPU patients are advised to avoid static pressure, for instance, by wearing soft shoes and tight clothing. Patients should understand that pressure is dependent on the weight encountered as well as the contact surface: When the weight force cannot be reduced, the contact area should be maximized. Recommended treatment regimens include nonsedating H1 antihistamines (evidence level B, best practice recommendation). The use of higher-than-standard doses is often needed and recommended in patients who do not show an improvement with standard doses of antihistamines (evidence level 0, best practice recommendation). Other possible treatment options include the combination of antihistamines and montelukast (evidence level A) (65–67), omalizumab (evidence level B, best practice recommendation) (18, 68, 69), dapsone (evidence level B) (70), sulfasalazine (evidence level B) (71, 72), anti-TNF (evidence level C) (73), or theophylline (evidence level C) (74).

Solar urticaria

Solar urticaria (SolU) is defined by the appearance of a whealing response within minutes of exposure to sunlight (Table 1) (75, 76). A diagnosis of SolU is made based on history and provocation phototest results. Provocation testing should be performed by exposure to ultraviolet radiation and visible light. The use of sunscreens and photoactive medications should be avoided before phototesting. Solar simulators with filters (UV-A and UV-B) or monochromator (UV-A and UV-B, visible light) should be used for provocation. Provocation testing should be carried out on the buttocks separately in the UV-A, broad-band UV-B wavelength spectra, and visible light range. UV-A should be tested on small test areas at 6 J/cm² and UV-B at 60 mJ/cm². In patients with a negative reaction, photosensitivity to visible light can be tested by using a projector (e.g., slide projector) at a distance of 10 cm. In SolU patients, provocation leads to a rapid urticarial response at the site of exposure within 10 min (Fig. 1). The test should be considered positive if the test site shows a palpable and clearly visible wheal and flare reaction. Wheals elicited by provocation are itchy and/or associated with a burning sensation.

In patients with a positive test reaction, threshold testing should be performed by varying the dose of the radiation, for example, by changing the time of exposure to the standard light source. This threshold testing (i.e., a minimal urticarial dose of an appropriate wavelength radiation) may allow for the determination of disease activity and response to therapy.

All SolU patients should avoid the sun, wear protective clothing, or use high protection sunscreens, especially when the threshold is in the ultraviolet spectrum, and treat with non-sedating H1 antihistamines (evidence level A, best practice recommendation) (77). Tolerance to UV light can be achieved by desensitization (evidence level B) (78, 79). Omalizumab (evidence level C) (18, 76, 80, 81), intravenous immunoglobulin treatment (evidence level B) (82–85), and cyclosporin (evidence level C) (86) have been reported to be beneficial in some patients, but not in others (84, 85, 87–90). Afamelanotide, an alpha-MSH analogue and melanocortin receptor agonist, also reportedly protects SolU patients from the development of signs and symptoms (evidence level B) (91).

Vibratory angioedema

Vibratory angioedema is defined by the presence of itching and swelling within minutes at the site of skin exposure to vibration (Table 2) (92, 93). For diagnostic purposes, vibratory angioedema can be reproduced using a laboratory vortex mixer. The forearm is held on a flat plate laid on the vortex mixer that is run between 780 rpm (92) to 1380 rpm (94) for 5 min. The site of application should be assessed for swelling 10 min after testing (Fig. 1). Measurement of the circumference of the arm before and after the challenge at three points (wrist, mid-forearm, and elbow) can help to define a vibration-induced swelling.

Vibratory angioedema is a very rare condition, and no information on demographics is available. Only a few case reports on treatments are available. Beyond the avoidance of exposure to vibratory stimulation, some authors describe H1 antihistamines as effective treatment options (evidence level C, best practice recommendation). Omalizumab treatment failed to improve vibratory angioedema in one case report (95).

Cholinergic urticaria

Cholinergic urticaria (CholU) is defined by itching, redness, and papular whealing induced by exercise and passive warming (e.g., hot bath). In some patients, emotional stress and hot and spicy food or beverages can also elicit symptoms. A typical description is one of tiny short-lived wheals with a pronounced flare reaction that is frequently localized to the trunk and limbs (96–101). Usually, skin lesions last for 15–60 min. Other morphological patterns, including angioedema, can occur. CholU must be differentiated from exercise-induced anaphylaxis, which is an anaphylactic reaction induced by physical activity only (102). Exercise-induced anaphylaxis can be food or drug dependent. In exercise-induced anaphylaxis, the skin symptoms usually start with distal pruritus (palmar, plantar, ears) followed by flushing and an erythematous or urticarial rash with large lesions. In contrast, CholU usually starts with small wheals, which may later converge.

Provocation testing should be performed to confirm CholU and to rule out exercise-induced anaphylaxis. Caution is advised in patients with pre-existing cardiac condi-

tions. Pretesting examination should be performed to record pre-existing skin lesions (e.g., acne papules), which may make assessment more difficult and can be marked with a pen before provocation test to identify them. Moderate physical exercise appropriate to the patient's age and general condition should be undertaken (e.g., on a treadmill or stationary bicycle). Exercise should be performed to the point of sweating and up to 15 min beyond or the onset of symptoms. Wearing warm clothing in a warm room facilitates the provocation tests. The test is positive if exercise challenge leads to the typical rash over 10 min. If the exercise provocation test is positive, a passive warming test should be carried out (at least 24 h later, 42°C full bath for up to 15 min, body temperature should increase by $\geq 1.0^\circ\text{C}$) to exclude exercise-induced anaphylaxis. Recently, a standardized protocol for diagnosing and measuring trigger thresholds using pulse-controlled ergometry has been published (103). For this pulse-controlled ergometry test, patients are seated on the bicycle ergometer and instructed to cycle in a pulse-controlled manner, that is, to speed up or slow down their pedaling speed to achieve an increase in pulse rate of 15 beats per minute every 5 min to a final maximum increase of 90 beats per minute above the starting level at 30 min. Time to whealing correlates with disease severity; in other words, the sooner wheals appear, the more active the ChIU.

In severely affected ChIU patients, the avoidance of overheating is essential, but almost impossible. Thus, symptomatic treatment is the first-choice therapy for ChIU. Nonsedating H1 antihistamines (evidence level A, best practice recommendation) (104, 105) and up dosing in nonresponders (evidence level 0, best practice recommendation) are effective in many patients, and there are reports on the efficacy of omalizumab (evidence level B, best practice recommendation) (106, 107), scopolamine butylbromide (evidence level C) (108), methantheliniumbromide (evidence level C) (109), combinations of propranolol, antihistamines, and montelukast (evidence level C) (110), and treatments and injections with botulinum toxin (evidence level C) (111). Desensitization protocols involving regular physical exercise (evidence level B) or treatment with autologous sweat have been described in some patients (112, 113). High doses of danazol (600 mg daily) were reported to be effective. However, the side-effect profile of danazol restricts its use (evidence level A, no recommendation) (114–116), and dosing should be minimized.

Aquagenic urticaria

Aquagenic urticaria is a rare form of CIndU, in which contact with any source of water—regardless of its temperature—evokes wheals. Within 30 min after contact to water, patients develop urticarial lesions, mostly 1–2 mm in size. Most cases are sporadic, although familial incidence has also been reported (117, 118). Systemic symptoms are rare, but have been described (119, 120). Aquagenic urticaria is sometimes associated with the forms of physical

urticaria. The pathomechanism remains unclear; however, there is some evidence that water acts as a carrier for an epidermal antigen (121). The condition must be differentiated from aquagenic pruritus, cholinergic urticaria, cold urticaria, and heat urticaria. These differential diagnoses should be ruled out before testing for aquagenic urticaria. For the diagnosis of aquagenic urticaria, a compress or a towel soaked with 35–37°C water or physiological saline is placed on the patient's trunk. The compress or the towel can be taken off after 40 min or earlier, if the patient reports pruritus and first wheals are seen at the skin test site. The test is positive if urticarial lesions develop inside the contact area within 10 min after taking off the compress/towel. Antihistamines are described as being effective in some patients (evidence level C, best practice recommendation) (122, 123). In other patients, a combination with UV therapy provided a benefit (evidence level C) (124, 125). A special barrier cream was reported to be effective (evidence level C) (126).

Contact urticaria

Contact urticaria is defined by the development of urticarial lesions within minutes (usually within 30 min) after contact to an exogenous agent. Contact urticaria is one of the cutaneous manifestations of the contact urticaria syndrome, which can manifest as contact wheals, systemic involvement, and even anaphylaxis (127). Contact urticaria is divided into nonimmunologic contact urticaria (NICU), immunologic contact urticaria (ICU), and indeterminate if the mechanism is unclear. NICU can occur at the very first contact to the eliciting agent such as plants (e.g., stinging nettle), animals (e.g., jelly fish), or chemicals (e.g., cinnamon aldehyde) (128–132). NICU lesions are strictly limited to the areas where the eliciting agent came in contact to the skin. ICU, in contrast, is an IgE-mediated reaction to proteins or hapten-forming molecules, and the reaction can spread beyond the area of contact into generalized urticaria and even evolve into systemic symptoms (133–135). One of the most common eliciting agents in ICU used to be latex, but reactions to plants or plant products, animal products, drugs, cosmetics, and chemicals are also frequently described. ICU elicited by foods or plants may also lead to signs and symptoms in the oral cavity when ingested (136).

After a thorough history, provocation testing should be performed to confirm NICU and ICU, using open controlled application testing, skin prick test, or closed patch tests for 20 min. No tests are necessary, when the eliciting agent is obvious, for example, stinging nettles or jellyfish. ICU diagnostics should be completed by the determination of specific IgE, if available. Avoidance of the eliciting agent is often possible, and antihistamines can help to prevent and decrease contact urticaria symptoms. Occupational ICU should be managed as other occupational skin diseases, by eliminating the allergen from the direct work environment and other measures to reduce levels of allergen exposure (137, 138).

Areas in need of further research

The following issues require further studies and research. 1. The underlying causes of CIndU with the exception of contact urticaria remain unknown. Further studies are needed to better characterize the etiology and pathogenesis of CIndU. 2. The prevalence and incidence of CIndU need to be investigated and, because regional geographical differences are to be expected, this should be a global effort. 3. Despite the current improvement of diagnostic tools and test protocols for some CIndUs, for example, cholinergic urticaria (103), further efforts are required to standardize and harmonize test protocols and to develop better tools for threshold testing in all CIndUs. 4. Specific quality of life instruments for cold urticaria, symptomatic dermographism, and cholinergic urticaria are under development, but tools for the other CIndUs are missing and should be developed.

Acknowledgments

We acknowledge that this update and revision of recommendations is based on a previous version published in this journal in 2009. We thank the COST action BM1007 'Mast cells and Basophils', the European Mast Cell and Basophil Research Network (www.embrn.eu), and the urticaria network e.V. (www.urtikaria.net) for support.

Conflict of interests

Dr. Altrichter has nothing to disclose. Dr. Borzova reports a sponsorship by Glaxo Smith Cline for the research in chronic spontaneous urticaria, outside the submitted work. Dr. Giménez-Arnau reports grants and personal fees from Uriach Pharma, grants and personal fees from Novartis Pharma, grants from Intendis Bayer, personal fees and other from GSK, personal fees and other from Leo

Pharma, grants and personal fees from Almirall, personal fees from Menarini, outside the submitted work. Dr. Grattan reports personal fees from Novartis, outside the submitted work. Dr. Magerl reports personal fees from Novartis, outside the submitted work, and is a scientific advisor of MOXIE GmbH. Dr. Maurer reports grants and personal fees from Novartis/Genentech, grants and personal fees from Uriach, grants and personal fees from FAES/Menarini, from Moxie, personal fees from MSD, outside the submitted work. Dr. Meshkova reports support for travel to meetings from Novartis Russia. Dr. Metz reports personal fees from Bayer, personal fees from Dr. R. Pflieger, personal fees from GSK, personal fees from Moxie, personal fees from Nerre, personal fees from Novartis, personal fees from Roche, personal fees from Sanofi, outside the submitted work. Dr. Zuberbier is consulting with the following companies: Ansell, Bayer Schering, DST, FAES, Fujisawa, HAL, Henkel, Kryolan, Leti, Menarini, Merck, MSD, Novartis, Procter and Gamble, Ranbaxy, Sanofi-Aventis, Schering Plough, Stallergenes, Takeda, UCB.

Author contributions

All authors provided a significant contribution to the manuscript by collecting data and providing scientific input. All authors wrote the manuscript, with a special focus on the following: E.B., R.Y.M., and M. Mau contributed to symptomatic dermographism; M.Me. and A.G-A contributed to cold urticaria and heat urticaria; C.E.H.G. and F.L. contributed to delayed pressure urticaria and vibratory angioedema; E.B. and P.M-F contributed to solar urticaria; S.A., P.M-F., and M.Mag contributed to cholinergic urticaria; M. Mau. and M. Mag contributed to aquagenic urticaria; and M. Mag. and A.G-A. contributed to contact urticaria. M. Mag. and M. Mau. consolidated the incoming contributions.

References

- Magerl M, Borzova E, Gimenez-Arnau A, Grattan CE, Lawlor F, Mathelier-Fusade P et al. The definition and diagnostic testing of physical and cholinergic urticarias—EAACI/GA2LEN/EDF/UNEV consensus panel recommendations. *Allergy* 2009;**64**:1715–1721.
- Zuberbier T, Aberer W, Asero R, Bindslev-Jensen C, Brzoza Z, Canonica GW et al. The EAACI/GA(2) LEN/EDF/WAO Guideline for the definition, classification, diagnosis, and management of urticaria: the 2013 revision and update. *Allergy* 2014;**69**:868–887.
- Vietri J, Turner SJ, Tian H, Isherwood G, Balp MM, Gabriel S. Effect of chronic urticaria on US patients: analysis of the National Health and Wellness Survey. *Ann Allergy Asthma Immunol* 2015;**115**:306–311.
- Weldon D. Quality of life in patients with urticaria and angioedema: assessing burden of disease. *Allergy Asthma Proc* 2014;**35**:4–9.
- Maurer M, Magerl M, Metz M, Siebenhaar F, Weller K, Krause K. Practical algorithm for diagnosing patients with recurrent wheals or angioedema. *Allergy* 2013;**68**:816–819.
- Leigh IM, Ramsay CA, Calnan CD. Cold urticaria—'desensitisation'. *Trans St Johns Hosp Dermatol Soc* 1974;**60**:40–42.
- Black AK, Sibbald RG, Greaves MW. Cold urticaria treated by induction of tolerance. *Lancet* 1979;**2**:964.
- Leigh IM, Ramsay CA. Localized heat urticaria treated by inducing tolerance to heat. *Br J Dermatol* 1975;**92**:191–194.
- Ramsay CA. Solar urticaria treatment by inducing tolerance to artificial radiation and natural light. *Arch Dermatol* 1977;**113**:1222–1225.
- Breathnach SM, Allen R, Ward AM, Greaves MW. Symptomatic dermographism: natural history, clinical features laboratory investigations and response to therapy. *Clin Exp Dermatol* 1983;**8**:463–476.
- Dice JP. Physical urticaria. *Immunol Allergy Clin North Am* 2004;**24**:225–246.
- Duke WW. Urticaria caused specifically by the action of physical agents: (light, cold, heat, freezing, burns, mechanical irritation, and physical and mental exertion). *J Am Med Assoc* 1924;**83**:3–9.
- Bettley FR. A device for the measurement of factitious urticaria. *J Invest Dermatol* 1962;**39**:1.
- Schoepke N, Abajian M, Church MK, Magerl M. Validation of a simplified provocation instrument for diagnosis and threshold testing of symptomatic dermographism. *Clin Exp Dermatol* 2015;**40**:399–403.

15. Magerl M, Schmolke J, Metz M, Zuberbier T, Siebenhaar F, Maurer M. Prevention of signs and symptoms of dermographic urticaria by single-dose ebastine 20 mg. *Clin Exp Dermatol* 2009;**34**:e137–e140.
16. Sharpe GR, Shuster S. The effect of cetirizine on symptoms and wealing in dermographic urticaria. *Br J Dermatol* 1993;**129**:580–583.
17. Krause K, Ardelean E, Kessler B, Magerl M, Metz M, Siebenhaar F et al. Antihistamine-resistant urticaria factitia successfully treated with anti-immunoglobulin E therapy. *Allergy* 2010;**65**:1494–1495.
18. Metz M, Altrichter S, Ardelean E, Kessler B, Krause K, Magerl M et al. Anti-immunoglobulin E treatment of patients with recalcitrant physical urticaria. *Int Arch Allergy Immunol* 2011;**154**:177–180.
19. Toda S, Takahagi S, Mihara S, Hide M. Six cases of antihistamine-resistant dermographic urticaria treated with oral ciclosporin. *Allergol Int* 2011;**60**:547–550.
20. Borzova E, Rutherford A, Konstantinou GN, Leslie KS, Grattan CE. Narrowband ultraviolet B phototherapy is beneficial in antihistamine-resistant symptomatic dermographism: a pilot study. *J Am Acad Dermatol* 2008;**59**:752–757.
21. Adamski H, Viguier M. Solar urticaria. *Ann Dermatol Venereol* 2012;**139**:324–328.
22. Hannuksela M, Kokkonen EL. Ultraviolet light therapy in chronic urticaria. *Acta Derm Venereol* 1985;**65**:449–450.
23. Johnsson M, Falk ES, Volden G. UVB treatment of factitious urticaria. *Photodermatol* 1987;**4**:302–304.
24. Logan RA, O'Brien TJ, Greaves MW. The effect of psoralen photochemotherapy (PUVA) on symptomatic dermographism. *Clin Exp Dermatol* 1989;**14**:25–28.
25. Mathelier-Fusade P, Leynadier F. Cold urticaria. *Ann Dermatol Venereol* 1994;**121**:429–433.
26. Wanderer AA. An 'allergy' to cold. *Hosp Pract* 1979;**14**:136–137.
27. Möller A, Henning M, Zuberbier T, Czarnetzki-Henz BM. Epidemiology and clinical aspects of cold urticaria. *Hautarzt* 1996;**47**:510–514.
28. Neittaanmaki H. Cold urticaria. Clinical findings in 220 patients. *J Am Acad Dermatol* 1985;**13**:636–644.
29. Wanderer AA. Essential acquired cold urticaria. *J Allergy Clin Immunol* 1990;**85**:531–532.
30. Krause K, Zuberbier T, Maurer M. Modern approaches to the diagnosis and treatment of cold contact urticaria. *Curr Allergy Asthma Rep* 2010;**10**:243–249.
31. Hochstadter EF, Ben-Shoshan M. Cold-induced urticaria: challenges in diagnosis and management. *BMJ Case Rep* 2013; doi:10.1136/bcr-2013-010441
32. Wanderer AA, Grandel KE, Wasserman SI, Farr RS. Clinical characteristics of cold-induced systemic reactions in acquired cold urticaria syndromes: recommendations for prevention of this complication and a proposal for a diagnostic classification of cold urticaria. *J Allergy Clin Immunol* 1986;**78**:417–423.
33. Gimenez-Arnau A, Serra-Baldrich E, Camarasa JG. Chronic aquagenic urticaria. *Acta Derm Venereol* 1992;**72**:389.
34. Magerl M, Abajian M, Krause K, Altrichter S, Siebenhaar F, Church MK. An improved Peltier effect-based instrument for critical temperature threshold measurement in cold- and heat-induced urticaria. *J Eur Acad Dermatol Venereol* 2015;**29**:2043–2045.
35. Siebenhaar F, Staubach P, Metz M, Magerl M, Jung J, Maurer M. Peltier effect-based temperature challenge: an improved method for diagnosing cold urticaria. *J Allergy Clin Immunol* 2004;**114**:1224–1225.
36. Koepfel MC, Bertrand S, Abitan R, Signoret R, Sayag J. Urticaria caused by cold. 104 cases. *Ann Dermatol Venereol* 1996;**123**:627–632.
37. Mathelier-Fusade P, Aissaoui M, Bakhos D, Chabane MH, Leynadier F. Clinical predictive factors of severity in cold urticaria. *Arch Dermatol* 1998;**134**:106–107.
38. Mlynck A, Magerl M, Siebenhaar F, Weller K, Vieira Dos Santos R, Zuberbier T et al. Results and relevance of critical temperature threshold testing in patients with acquired cold urticaria. *Br J Dermatol* 2010;**162**:198–200.
39. Illig L. Positive side-effects of antibiotic and antimicrobial drugs in therapy (author's transl). *Infection* 1979;**7**(Suppl. 6):584–588.
40. Magerl M, Schmolke J, Siebenhaar F, Zuberbier T, Metz M, Maurer M. Acquired cold urticaria symptoms can be safely prevented by ebastine. *Allergy* 2007;**62**:1465–1468.
41. Metz M, Scholz E, Ferran M, Izquierdo I, Gimenez-Arnau A, Maurer M. Rupatadine and its effects on symptom control, stimulation time, and temperature thresholds in patients with acquired cold urticaria. *Ann Allergy Asthma Immunol* 2010;**104**:86–92.
42. Weinstein ME, Wolff AH, Bielory L. Efficacy and tolerability of second- and third-generation antihistamines in the treatment of acquired cold urticaria: a meta-analysis. *Ann Allergy Asthma Immunol* 2010;**104**:518–522.
43. Abajian M, Curto-Barredo L, Krause K, Santamaria E, Izquierdo I, Church MK et al. Rupatadine 20 mg and 40 mg are effective in reducing the symptoms of chronic cold urticaria. *Acta Derm Venereol* 2016;**96**:56–59.
44. Krause K, Spohr A, Zuberbier T, Church MK, Maurer M. Up-dosing with bilastine results in improved effectiveness in cold contact urticaria. *Allergy* 2013;**68**:921–928.
45. Magerl M, Pisarevskaja D, Staubach P, Martus P, Church MK, Maurer M. Critical temperature threshold measurement for cold urticaria: a randomized controlled trial of H(1)-antihistamine dose escalation. *Br J Dermatol* 2012;**166**:1095–1099.
46. Martinez-Escala ME, Curto-Barredo L, Carnero L, Pujol RM, Gimenez-Arnau AM. Temperature thresholds in assessment of the clinical course of acquired cold contact urticaria: a prospective observational one-year study. *Acta Derm Venereol* 2015;**95**:278–282.
47. Siebenhaar F, Degener F, Zuberbier T, Martus P, Maurer M. High-dose desloratadine decreases wheal volume and improves cold provocation thresholds compared with standard-dose treatment in patients with acquired cold urticaria: a randomized, placebo-controlled, crossover study. *J Allergy Clin Immunol* 2009;**123**:672–679.
48. Boyce JA. Successful treatment of cold-induced urticaria/anaphylaxis with anti-IgE. *J Allergy Clin Immunol* 2006;**117**:1415–1418.
49. Brodsky P, Schmid-Grendelmeier P. Treatment of severe cold contact urticaria with omalizumab: case reports. *Case Rep Dermatol* 2012;**4**:275–280.
50. Le Moing A, Becourt C, Pape E, Dejobert Y, Delaporte E, Staumont-Salle D. Effective treatment of idiopathic chronic cold urticaria with omalizumab: report of 3 cases. *J Am Acad Dermatol* 2013;**69**:e99–e101.
51. Kring Tannert L, Stahl SP, Bjerremann JL, Maurer M, Bindslev-Jensen C. Cold urticaria patients exhibit normal skin levels of functional mast cells and histamine after tolerance induction. *Dermatology* 2012;**224**:101–105.
52. von Mackensen YA, Sticherling M. Cold urticaria: tolerance induction with cold baths. *Br J Dermatol* 2007;**157**:835–836.
53. Bodar EJ, Simon A, de Visser M, van der Meer JW. Complete remission of severe idiopathic cold urticaria on interleukin-1 receptor antagonist (anakinra). *Neth J Med* 2009;**67**:302–305.
54. Gualdi G, Monari P, Rossi MT, Crotti S, Calzavara-Pinton PG. Successful treatment of systemic cold contact urticaria with etanercept in a patient with psoriasis. *Br J Dermatol* 2012;**166**:1373–1374.
55. Chang A, Zic JA. Localized heat urticaria. *J Am Acad Dermatol* 1999;**41**:354–356.

56. Koh YI, Choi IS, Lee SH, Lee JB, Park CH, Hong SN. Localized heat urticaria associated with mast cell and eosinophil degranulation. *J Allergy Clin Immunol* 2002;**109**:714–715.
57. Irwin RB, Lieberman P, Friedman MM, Kaliner M, Kaplan R, Bale G et al. Mediator release in local heat urticaria: protection with combined H1 and H2 antagonists. *J Allergy Clin Immunol* 1985;**76**:35–39.
58. Tomi NS, Schuster C, Bechara F, Hoffmann K, Kränke B. Localized heat urticaria in a child. *J Eur Acad Dermatol Venereol* 2008;**22**:384–386.
59. Bullerkotte U, Wiczorek D, Kapp A, Wedi B. Effective treatment of refractory severe heat urticaria with omalizumab. *Allergy* 2010;**65**:931–932.
60. Carballada F, Nunez R, Martin-Lazaro J, Juarez Y, Castineira I, Fernandez L et al. Omalizumab treatment in 2 cases of refractory heat urticaria. *J Investig Allergol Clin Immunol* 2013;**23**:519–521.
61. Lawlor F, Black AK. Delayed pressure urticaria. *Immunol Allergy Clin North Am* 2004;**24**:247–258.
62. Lawlor F, Black AK, Ward AM, Morris R, Greaves MW. Delayed pressure urticaria, objective evaluation of a variable disease using a dermatographometer and assessment of treatment using colchicine. *Br J Dermatol* 1989;**120**:403–408.
63. Ryan TJ, Shim-Young N, Turk JL. Delayed pressure urticaria. *Br J Dermatol* 1968;**80**:485–490.
64. Barlow RJ, Warburton F, Watson K, Black AK, Greaves MW. Diagnosis and incidence of delayed pressure urticaria in patients with chronic urticaria. *J Am Acad Dermatol* 1993;**29**:954–958.
65. Nettis E, Colanardi MC, Soccio AL, Ferrannini A, Vacca A. Desloratadine in combination with montelukast suppresses the dermatographometer challenge test papule, and is effective in the treatment of delayed pressure urticaria: a randomized, double-blind, placebo-controlled study. *Br J Dermatol* 2006;**155**:1279–1282.
66. Nettis E, Pannofino A, Cavallo E, Ferrannini A, Tursi A. Efficacy of montelukast, in combination with loratadine, in the treatment of delayed pressure urticaria. *J Allergy Clin Immunol* 2003;**112**:212–213.
67. Berkun Y, Shalit M. Successful treatment of delayed pressure urticaria with montelukast. *Allergy* 2000;**55**:203–204.
68. Bindslev-Jensen C, Skov PS. Efficacy of omalizumab in delayed pressure urticaria: a case report. *Allergy* 2010;**65**:138–139.
69. Rodriguez-Rodriguez M, Antolin-Amerigo D, Barbarroja-Escudero J, Sanchez-Gonzalez MJ, Alvarez-Mon M. Successful treatment of severe delayed pressure angioedema with omalizumab. *Allergol Immunopathol (Madr)* 2014;**42**:78–80.
70. Grundmann SA, Kiefer S, Luger TA, Brehler R. Delayed pressure urticaria – dapsona heading for first-line therapy? *J Dtsch Dermatol Ges* 2011;**9**:908–912.
71. Engler RJ, Squire E, Benson P. Chronic sulfasalazine therapy in the treatment of delayed pressure urticaria and angioedema. *Ann Allergy Asthma Immunol* 1995;**74**:155–159.
72. Swerlick RA, Puhar N. Delayed pressure urticaria: response to treatment with sulfasalazine in a case series of seventeen patients. *Dermatol Ther* 2015;**28**:318–322.
73. Magerl M, Philipp S, Manasterski M, Friedrich M, Maurer M. Successful treatment of delayed pressure urticaria with anti-TNF-alpha. *J Allergy Clin Immunol* 2007;**119**:752–754.
74. Kalogeromitros D, Kempuraj D, Katsarou-Katsari A, Gregoriou S, Makris M, Boucher W et al. Theophylline as “add-on” therapy in patients with delayed pressure urticaria: a prospective self-controlled study. *Int J Immunopathol Pharmacol* 2005;**18**:595–602.
75. Chong WS, Khoo SW. Solar urticaria in Singapore: an uncommon photodermatosis seen in a tertiary dermatology center over a 10-year period. *Photodermatol Photoimmunol Photomed* 2004;**20**:101–104.
76. Guzelbey O, Ardelean E, Magerl M, Zuberbier T, Maurer M, Metz M. Successful treatment of solar urticaria with anti-immunoglobulin E therapy. *Allergy* 2008;**63**:1563–1565.
77. Bilsland D, Ferguson J. A comparison of cetirizine and terfenadine in the management of solar urticaria. *Photodermatol Photoimmunol Photomed* 1991;**8**:62–64.
78. Masuoka E, Fukunaga A, Kishigami K, Jimbo H, Nishioka M, Uchimura Y et al. Successful and long-lasting treatment of solar urticaria with ultraviolet A rush hardening therapy. *Br J Dermatol* 2012;**167**:198–201.
79. Wolf R, Herzinger T, Grahovac M, Prinz JC. Solar urticaria: long-term rush hardening by inhibition spectrum narrow-band UVB 311 nm. *Clin Exp Dermatol* 2013;**38**:446–447.
80. Baliu-Pique C, Aguilera PP. Three cases of solar urticaria successfully treated with omalizumab. *J Eur Acad Dermatol Venereol* 2016;**30**:704–706.
81. Levi A, Tal Y, Dranitzki Z, Shalit M, Enk CD. Successful omalizumab treatment of severe solar urticaria in a 6-year old child. *Pediatr Allergy Immunol* 2015;**26**:588–590.
82. Correia I, Silva J, Filipe P, Gomes M. Solar urticaria treated successfully with intravenous high-dose immunoglobulin: a case report. *Photodermatol Photoimmunol Photomed* 2008;**24**:330–331.
83. Hughes R, Cusack C, Murphy GM, Kirby B. Solar urticaria successfully treated with intravenous immunoglobulin. *Clin Exp Dermatol* 2009;**34**:e660–e662.
84. Adamski H, Bedane C, Bonneville A, Thomas P, Peyron JL, Rouchouse B et al. Solar urticaria treated with intravenous immunoglobulins. *J Am Acad Dermatol* 2011;**65**:336–340.
85. Aubin F, Porcher R, Jeanmougin M, Leonard F, Bedane C, Moreau A et al. Severe and refractory solar urticaria treated with intravenous immunoglobulins: a phase II multicenter study. *J Am Acad Dermatol* 2014;**71**:948–953.
86. Edstrom DW, Ros AM. Cyclosporin A therapy for severe solar urticaria. *Photodermatol Photoimmunol Photomed* 1997;**13**:61–63.
87. Duchini G, Baumler W, Bircher AJ, Scherer K. Failure of omalizumab (Xolair (R)) in the treatment of a case of solar urticaria caused by ultraviolet A and visible light. *Photodermatol Photoimmunol Photomed* 2011;**27**:336–337.
88. Llamas-Velasco M, Argila DD, Eguren C, Garcia-Martin P, Ibanes S, Garcia-Diez A. Solar urticaria unresponsive to intravenous immunoglobulins. *Photodermatol Photoimmunol Photomed* 2011;**27**:53–54.
89. Müller S, Schempp CM, Jakob T. Failure of omalizumab in the treatment of solar urticaria. *J Eur Acad Dermatol Venereol* 2016;**30**:524–525.
90. Hurabielle C, Bedane C, Avenel-Audran M, Adamski H, Aubin F, Jeanmougin M et al. No Major effect of cyclosporine in patients with severe solar urticaria: a french retrospective case series. *Acta Derm Venerol* 2015;**95**:1030–1031.
91. Haylett AK, Nie Z, Brownrigg M, Taylor R, Rhodes LE. Systemic photoprotection in solar urticaria with alpha-melanocyte-stimulating hormone analogue [Nle4-D-Phe7]-alpha-MSH. *Br J Dermatol* 2011;**164**:407–414.
92. Lawlor F, Black AK, Breathnach AS, Greaves MW. Vibratory angioedema: lesion induction, clinical features, laboratory and ultrastructural findings and response to therapy. *Br J Dermatol* 1989;**120**:93–99.
93. Mathelier-Fusade P, Vermeulen C, Leynadier F. Vibratory angioedema. *Ann Dermatol Venereol* 2001;**128**:750–752.
94. Keahey TM, Indrisano J, Lavker RM, Kaliner MA. Delayed vibratory angioedema: insights into pathophysiologic mechanisms. *J Allergy Clin Immunol* 1987;**80**:831–838.

95. Pressler A, Grosber M, Halle M, Ring J, Brockow K. Failure of omalizumab and successful control with ketotifen in a patient with vibratory angio-oedema. *Clin Exp Dermatol* 2013;**38**:151–153.
96. Czarnetzki BM. Ketotifen in cholinergic urticaria. *J Allergy Clin Immunol* 1990;**86**:138–139.
97. Illig L. On the pathogenesis of cholinergic urticaria. I. Clinical observations and histological studies. *Arch Klin Exp Dermatol* 1967;**229**:231–247.
98. Illig L, Heinicke A. On the pathogenesis of cholinergic urticaria. II. Studies on the relationships of cholinergic urticaria to sweat secretions with the help of various cholinomimetics. *Arch Klin Exp Dermatol* 1967;**229**:285–299.
99. Illig L, Heinicke A. On the pathogenesis of cholinergic urticaria. 3. The influence of sweat secretion inhibition on cholinergic urticaria. *Arch Klin Exp Dermatol* 1967;**229**:345–359.
100. Illig L, Heinicke A. On the pathogenesis of cholinergic urticaria. IV. On the problem of a true antigen-antibody reaction. *Arch Klin Exp Dermatol* 1967;**229**:360–371.
101. Illig L, Heinicke A. Pathogenesis of cholinergic urticaria. V. The pharmacologic reactivity of the Prausnitz-Kustner reaction and the origin of the antigen. *Arch Klin Exp Dermatol* 1967;**230**:34–47.
102. Montgomery SL. Cholinergic urticaria and exercise-induced anaphylaxis. *Curr Sports Med Rep* 2015;**14**:61–63.
103. Altrichter S, Salow J, Ardelean E, Church MK, Werner A, Maurer M. Development of a standardized pulse-controlled ergometry test for diagnosing and investigating cholinergic urticaria. *J Dermatol Sci* 2014;**75**:88–93.
104. Zuberbier T, Aberer W, Burtin B, Rihoux JP, Czarnetzki BM. Efficacy of cetirizine in cholinergic urticaria. *Acta Derm Venereol* 1995;**75**:147–149.
105. Zuberbier T, Munzberger C, Hausteiner U, Trippas E, Burtin B, Mariz SD et al. Double-blind crossover study of high-dose cetirizine in cholinergic urticaria. *Dermatology* 1996;**193**:324–327.
106. Metz M, Bergmann P, Zuberbier T, Maurer M. Successful treatment of cholinergic urticaria with anti-immunoglobulin E therapy. *Allergy* 2008;**63**:247–249.
107. Kutlu A, Tanoglu A, Ozturk S. Healing effects of omalizumab in a patient with cholinergic urticaria associated severe dyspeptic complaints. *Chin Med J (Engl)* 2015;**128**:1559–1560.
108. Ujiie H, Shimizu T, Natsuga K, Arita K, Tomizawa K, Shimizu H. Severe cholinergic urticaria successfully treated with scopolamine butylbromide in addition to antihistamines. *Clin Exp Dermatol* 2006;**31**:588–589.
109. Altrichter S, Wosny K, Maurer M. Successful treatment of cholinergic urticaria with methanthelinumbromide. *J Dermatol* 2015;**42**:422–424.
110. Feinberg JH, Toner CB. Successful treatment of disabling cholinergic urticaria. *Mil Med* 2008;**173**:217–220.
111. Sheraz A, Halpern S. Cholinergic urticaria responding to botulinum toxin injection for axillary hyperhidrosis. *Br J Dermatol* 2013;**168**:1369–1370.
112. Kozaru T, Fukunaga A, Taguchi K, Ogura K, Nagano T, Oka M et al. Rapid desensitization with autologous sweat in cholinergic urticaria. *Allergol Int* 2011;**60**:277–281.
113. Nakamizo S, Egawa G, Miyachi Y, Kabashima K. Cholinergic urticaria: pathogenesis-based categorization and its treatment options. *J Eur Acad Dermatol Venereol* 2012;**26**:114–116.
114. Berth-Jones J, Graham-Brown RA. Cholinergic pruritus, erythema and urticaria: a disease spectrum responding to danazol. *Br J Dermatol* 1989;**121**:235–237.
115. La Shell MS, England RW. Severe refractory cholinergic urticaria treated with danazol. *J Drugs Dermatol* 2006;**5**:664–667.
116. Wong E, Eftekhari N, Greaves MW, Ward AM. Beneficial effects of danazol on symptoms and laboratory changes in cholinergic urticaria. *Br J Dermatol* 1987;**116**:553–556.
117. Pitarch G, Torrijos A, Martinez-Menchon T, Sanchez-Carazo JL, Fortea JM. Familial aquagenic urticaria and Bernard-Soulier syndrome. *Dermatology* 2006;**212**:96–97.
118. Seize MB, Ianhez M, de SP, Rotta O, Cesar Sda C. Familial aquagenic urticaria: report of two cases and literature review. *An Bras Dermatol* 2009;**84**:530–533.
119. Baptist AP, Baldwin JL. Aquagenic urticaria with extracutaneous manifestations. *Allergy Asthma Proc* 2005;**26**:217–220.
120. Luong KV, Nguyen LT. Aquagenic urticaria: report of a case and review of the literature. *Ann Allergy Asthma Immunol* 1998;**80**:483–485.
121. Czarnetzki BM, Bretholt KH, Traupe H. Evidence that water acts as a carrier for an epidermal antigen in aquagenic urticaria. *J Am Acad Dermatol* 1986;**15**:623–627.
122. Yavuz ST, Sahiner UM, Tuncer A, Sackesen C. Aquagenic urticaria in 2 adolescents. *J Invest Allergol Clin Immunol* 2010;**20**:624–625.
123. Park H, Kim HS, Yoo DS, Kim JW, Kim CW, Kim SS et al. Aquagenic urticaria: a report of two cases. *Ann Dermatol* 2011;**23** (Suppl. 3):S371–S374.
124. Parker RK, Crowe MJ, Guin JD. Aquagenic urticaria. *Cutis* 1992;**50**:283–284.
125. Martinez-Escribano JA, Quecedo E, De la Cuadra J, Frias J, Sanchez-Pedreno P, Aliaga A. Treatment of aquagenic urticaria with PUVA and astemizole. *J Am Acad Dermatol* 1997;**36**:118–119.
126. Bayle P, Gadroy A, Messer L, Bazex J. Localized aquagenic urticaria: efficacy of a barrier cream. *Contact Dermatitis* 2003;**49**:160–161.
127. Gimenez-Arnau AM, Maibach HI. *Contact Urticaria Syndrome*. Boca Raton: CRC Press Taylor & Francis Group, 2015.
128. Lahti A. Non-immunologic contact urticaria. *Acta Derm Venereol Suppl (Stockh)* 1980;**60**:Suppl. 91:1–49.
129. Lahti A. Non-immunologic contact urticaria. Animal tests and their relevance. *Acta Derm Venereol Suppl (Stockh)* 1988;**135**:43–44.
130. Oliver F, Amon EU, Brethnach A, Francis DM, Sarathchandra P, Black AK et al. Contact urticaria due to the common stinging nettle (*Urtica dioica*)—histological, ultrastructural and pharmacological studies. *Clin Exp Dermatol* 1991;**16**:1–7.
131. Fischer TW, Bauer A, Hipler UC, Elsner P. Non-immunologic contact urticaria from chrysanthemum confirmed by the CAST method. Complement-activated (C5a) cellular antigen stimulation test. *Contact Dermatitis* 1999;**41**:293–295.
132. Zhai H, Zheng Y, Fautz R, Fuchs A, Maibach HI. Reactions of non-immunologic contact urticaria on scalp, face, and back. *Skin Res Technol* 2012;**18**:436–441.
133. Wakelin SH. Contact urticaria. *Clin Exp Dermatol* 2001;**26**:132–136.
134. Gimenez-Arnau A, Maurer M, De La Cuadra J, Maibach H. Immediate contact skin reactions, an update of Contact Urticaria, Contact Urticaria Syndrome and Protein Contact Dermatitis – “A Never Ending Story”. *Eur J Dermatol* 2010;**20**:552–562.
135. Gimenez-Arnau A. Contact urticaria and the environment. *Rev Environ Health* 2014;**29**:207–215.
136. Wang CY, Maibach HI. Immunologic contact urticaria—the human touch. *Cutan Ocul Toxicol* 2013;**32**:154–160.
137. Adisesh A, Robinson E, Nicholson PJ, Sen D, Wilkinson M. U.K. standards of care for occupational contact dermatitis and occupational contact urticaria. *Br J Dermatol* 2013;**168**:1167–1175.
138. Bensefa-Colas L, Telle-Lamberton M, Faye S, Bourrain JL, Crepy MN, Lasfargues G et al. Occupational contact urticaria: lessons from the French National Network for Occupational Disease Vigilance and Prevention (RNV3P). *Br J Dermatol* 2015;**173**:1453–1461.

139. Johnson RF. Letter: incidence of dermographism. *Br Med J* 1976;**1**:1533–1534.
140. Kirby JD, Matthews CN, James J, Duncan EH, Warin RP. The incidence and other aspects of factitious wealing (dermographism). *Br J Dermatol* 1971;**85**:331–335.
141. Kontou-Fili K, Borici-Mazi R, Kapp A, Matjevic LJ, Mitchel FB. Physical urticaria: classification and diagnostic guidelines. An EAACI position paper. *Allergy* 1997;**52**:504–513.
142. Abajian M, Mlynek A, Maurer M. Physical urticaria. *Curr Allergy Asthma Rep* 2012;**12**:281–287.
143. Fleischer M, Grabbe J. Physical urticaria. *Hautarzt* 2004;**55**:344–349.
144. Zuberbier T, Maurer M. Urticaria: current opinions about etiology, diagnosis and therapy. *Acta Derm Venereol* 2007;**87**:196–205.
145. Siebenhaar F, Weller K, Mlynek A, Magerl M, Altrichter S, Vieira Dos Santos R et al. Acquired cold urticaria: clinical picture and update on diagnosis and treatment. *Clin Exp Dermatol* 2007;**32**:241–245.
146. Dover JS, Black AK, Ward AM, Greaves MW. Delayed pressure urticaria. Clinical features, laboratory investigations, and response to therapy of 44 patients. *J Am Acad Dermatol* 1988;**18**:1289–1298.
147. Sussman GL, Harvey RP, Schocket AL. Delayed pressure urticaria. *J Allergy Clin Immunol* 1982;**70**:337–342.
148. Uetsu N, Miyauchi-Hashimoto H, Okamoto H, Horio T. The clinical and photobiological characteristics of solar urticaria in 40 patients. *Br J Dermatol* 2000;**142**:32–38.
149. Eguino P, Lasa O, Gardeazabal J, Diaz-Perez JL. Solar urticaria. Study of 20 cases. *Actas Dermosifiliogr* 2005;**96**:25–29.
150. Monfrecola G, Masturzo E, Riccardo AM, Balato F, Ayala F, Di Costanzo MP. Solar urticaria: a report on 57 cases. *Am J Contact Dermat* 2000;**11**:89–94.
151. Godse K, Farooqui S, Nadkarni N, Patil S. Prevalence of cholinergic urticaria in Indian adults. *Indian Dermatol Online J* 2013;**4**:62–63.
152. Silpa-archa N, Kulthanan K, Pinkaew S. Physical urticaria: prevalence, type and natural course in a tropical country. *J Eur Acad Dermatol Venereol* 2011;**25**:1194–1199.
153. Zuberbier T, Althaus C, Chantraine-Hess S, Czarnetzki BM. Prevalence of cholinergic urticaria in young adults. *J Am Acad Dermatol* 1994;**31**:978–981.
154. Kim JE, Eun YS, Park YM, Park HJ, Yu DS, Kang H et al. Clinical characteristics of cholinergic urticaria in Korea. *Ann Dermatol* 2014;**26**:189–194.
155. Moore-Robinson M, Warin RP. Some clinical aspects of cholinergic urticaria. *Br J Dermatol* 1968;**80**:794–799.