



Risk of anaphylaxis in complementary and alternative medicine

Natasha C. Gunawardana

Purpose of review

Complementary and alternative medicine (CAM) use is widespread across the world. Patients with asthma and allergy regularly use CAM therapies. Allergic and anaphylactic reactions to CAM have been reported.

Recent findings

Recent attempts to regulate and monitor adverse reaction to these therapies have given us further insight into potential causes of severe allergic reactions. Several culprits identified including *Andrographis paniculata*, *Echinacea* species, bee products, *Ginkgo biloba* and Ginseng are discussed here.

Summary

Knowing the factors that increase the risk of anaphylaxis allows reactions to be recognized, reported and further investigated. Research to identify key causative allergens is necessary in the future. Collaboration between the allergy community and CAM practitioners can allow better understanding of allergy to these therapies.

Keywords

anaphylaxis, complementary and alternative medicine

INTRODUCTION

Complementary and alternative medicine (CAM) comprises a range of therapies, practices and health-care systems that are used to promote and improve health outside the scope of current mainstream conventional medicine [1] (Table 1). It is difficult to have an accepted, practical definition of CAM and difficult to define when therapies that may be considered complementary may then be accepted in conventional medicine [1]. This has implications for regulation of these therapies and a potential increase in the risk of adverse events. The therapies range from physical treatments such as osteopathy, chiropractic and acupuncture that are increasingly accepted in conventional medicine to herbal medicines, Ayurveda and nutritional therapies [2]. The use of CAM is widespread and therapies have frequently been in use for hundreds of years. Patients with long-term, incurable medical conditions like cancer, arthritis, chronic back pain, chronic renal failure, asthma and allergies commonly use CAM [3]. Perception of these therapies as inherently well tolerated with fewer side-effects can lead to their use without the same precautions exercised over the use of conventional medicines [4–7] increasing the risk of adverse reactions. The risk of anaphylaxis with CAM is dependent on the prevalence of use, the

intrinsic allergenicity of the substances used, cross reactions with known allergens, the method of administration and contamination with products that could lead to allergic reactions. Alongside allergic and anaphylactic reactions, many people experience side-effects or toxicity reactions either due to the therapy alone or due to interactions when CAM is used in conjunction with other medications.

PREVALENCE OF COMPLEMENTARY AND ALTERNATIVE MEDICINE USE

There is considerable variation in the estimated prevalence of CAM use across many countries and the methodologies used to estimate prevalence can be poor and inconsistent making the true scope of use unknown [8]. In the most recent 2012 US National Health Survey 33.2% of adults had used CAM with 18% of adults using natural products

Allergy Department, Royal Brompton Hospital, London, United Kingdom
Correspondence to Natasha C. Gunawardana, Allergy Department, Royal Brompton Hospital, Fulham Road, London SW3 6NP, United Kingdom. Tel: +44 2073518024; fax: +44 2073497780; e-mail: n.gunawardana@imperial.ac.uk

Curr Opin Allergy Clin Immunol 2017, 17:332–337

DOI:10.1097/ACI.0000000000000384

KEY POINTS

- CAM use is highly prevalent, especially in patients with asthma and allergy.
- CAM therapies are often contaminated with potential allergens.
- Anaphylaxis mainly occurs to herbal and intravenous therapies.
- *Andrographis paniculata*, *Echinacea* species, bee products, *Ginkgo biloba* and Ginseng are better identified causes of anaphylaxis.

including at least one herbal medicine during the past 12 months [9[■]]. Estimates in UK vary from 20 to 28% [6]. Seventy percent of Germans have used CAM in the last year [10] and in Canada 12% of the population have seen a CAM practitioner in the last year [11]. Asian countries and economically disadvantaged countries have higher rates of use. It is estimated that up to 80% of developing country populations rely on CAM as their primary medical treatment [10]. The highest documented use is in eastern Asian countries, where the estimated prevalence is 76% in Japan, 75% in South Korea and 56% in Malaysia. Rates have remained fairly constant and do not seem to be increasing though the prevalence of different modalities may vary over time [11]. The most commonly used herbal medicine and dietary supplements in the United States across the years were chondroitin, coenzyme Q-10, *Echinacea* species, fish oil, garlic supplements, ginkgo, ginseng, and glucosamine [6].

There is a high incidence of herbal use amongst patients with known allergies [12,13]. Forty-nine percent of patients with asthma in the UK have used CAM therapies and 30–50% of patients with allergies have used CAM in Europe [13]. Medicines commonly used in asthma and allergies include Vitamin C and D supplementation, probiotics, fish oils, butterbur, caffeine and capsaicin with variable degrees of efficacy [12]. A recent survey of allergy specialists with experience in CAM had patients who used (in decreasing order) herbal medicines (67.6%), vitamins (61.9%), probiotics (57.7%), fish oil/omega-3 (57.7%) and *Echinacea* spp. (38.0%) and 59.7% of respondents said they had seen an adverse reaction in relation to CAM [14[■]].

REGULATION OF COMPLEMENTARY AND ALTERNATIVE MEDICINE

Worldwide, there is poor regulation of the manufacture, ingredients and distribution systems of

CAM medications [10]. This frequently leads to contamination with toxic products and over the counter medications [15] and can make it hard to determine the cause of subsequent adverse reactions. A recent meta-analysis into contamination and adulteration of herbal medicinal products showed this to be most prevalent in traditional Chinese medicine and traditional Indian medicine [15]. Medicines were found that contained a variety of prescription drugs including steroids and nonsteroidal anti-inflammatory drugs; contaminants such as dust; parasites; microbes such as *Escherichia coli*, *Salmonella* and *Listeria*; toxic heavy metals; pesticides and other toxic chemicals [15,16[■]].

There are currently worldwide attempts to regulate CAM therapies, their manufacture and distribution. The European parliament has passed resolutions to harmonise the regulation of nonconventional medicine [4]. All herbal and homeopathic products used in the European union (EU) are now monitored with the same procedures as other medicinal products [17]. It is illegal to sell unlicensed products in the EU, with central monitoring by the European Medicines Agency and national monitoring by regulatory bodies in individual countries [4]. However, there is still considerable variability in regulation across countries within the EU; different modalities of CAM have varying levels of regulation with little imposed regulation of CAM practitioners [17].

REPORTING OF ADVERSE REACTIONS

The monitoring of adverse reactions to CAM is less stringent but improving. Following the publication of 2005 World Health Organisation (WHO) guidance [10], the WHO international pharmacovigilance database (VigiBase) collected data on adverse reactions to CAM therapies. The Uppsala Monitoring Centre in Sweden collates information for VigiBase from national databases maintained by member states [10]. However, this is currently reliant on voluntary reporting of adverse events and is hence likely to underrepresent the scope of the problem [18]. VigiBase does not currently allow for data to be collected on any validation of reported type 1 hypersensitivity reactions [19[■]].

To further confound this, patients are also less likely to inform their physician if they are using CAM therapies and physicians are poor at documenting their use [20,14[■]]. Patients are also unlikely to report adverse reactions to these therapies to physicians than reactions to conventional medications [21].

Most published literature on type 1 hypersensitivity reactions to CAM therapies involves case

Table 1. Types of complimentary and alternative medicine

Traditional alternative medicine	Body	Diet and herbs	External energy	Mind	Senses
Acupuncture and acupressure	Chiropractic and osteopathic medicine	Dietary supplements (vitamins, hormones, amino acids)	Electromagnetic therapy	Meditation	Arts therapy (dance, drama and music)
Homeopathy	Massage	Herbal supplements	Reiki	Biofeedback	Visualisation and guided imagery
Ayurveda	Body movement therapies	Diet therapy	Qigong	Hypnosis	Aromatherapy
Naturopathy	Alexander technique	Macrobiotic diet	Energy fieldwork	Breathwork	Colour therapy
Traditional Chinese medicine	Tai chi	Bee products	Distant healing	Gestalt therapy	Light therapy
Other traditional healers and healing practices (e.g. Shamanism, Kampo)	Yoga		Feng shui	Relaxation techniques	Snoezelen
	Craniosacral manipulation		Therapeutic touch	Play therapy	
	Feldenkrais therapy		Ultrasonic therapy	Eye movement desensitisation and reproprocessing	
	Balneootherapy			Morita therapy	
	Electric stimulation therapy			Spiritual healing	
	Hydrotherapy				
	Hyperbaric oxygen therapy				
	Moxibustion				
	Ozone therapy				
	Prolotherapy				
	Reflexology				
	Speleootherapy				
	Tui na				

Based on information from reference [1].

reports or case series [22]. These, especially in the case of traditional Chinese medicine and traditional Indian medicine, are published in journals that are not frequently read by practitioners of conventional medicine, are regularly published in the language of the country of origin and rarely translated. The evidence basis is hence subject to significant selection and language bias. There is also limited use of conventionally used investigations such as skin prick testing, intradermal testing, other in vitro testing and the use of controls in diagnosing sensitisation and allergy.

ANAPHYLAXIS IN COMPLEMENTARY AND ALTERNATIVE MEDICINE

Anaphylactic and allergic reactions are more likely to develop on exposure to ingested or internalised treatments [23]. Herbal treatments in traditional Chinese medicine and Ayurveda have the highest reported rates of anaphylactic reactions [24[¶]]. Zeng and Jlang [23] reported 3122 adverse drug reactions amongst 140 different kinds of traditional Chinese medicine drugs. One hundred and twenty-eight cases of anaphylactic shock were reported (4.1% of total adverse reactions) and 108 were to intravenous injections.

Reactions are more common in women or reported more commonly in women [13]. Asthma and other atopic diseases may also predispose to developing allergies to CAM therapies [25].

A recent retrospective study looked for potential allergy-like immediate reactions with herbal medicines reported to the WHO's VigiBase from 1969 to 2014 with data collected from 42 countries [19^{¶¶}]. The number of immediate allergy-like adverse reactions after use of herbals was 757 during this period. On reviewing these cases, a causative relationship was deemed 'possible' in 59%, 'probable' in 32% and 'certain' in 8.6%, though this again did not specify whether the culprit agents were further investigated. Anaphylactic and anaphylactoid reactions accounted for 9.5% of the identified reactions. There were no deaths documented and a complete recovery was documented in 77.7%. Thirty-six percent of all immediate allergy-type reactions identified in VigiBase were to mixed herbal preparations [19^{¶¶}]. This makes it difficult to elucidate a single culprit. There was a wide range of single herbal treatments identified, with the commonest causes being *Phleum pratense* (6.5%), *Andrographis paniculata* (5%), *Echinacea purpurea* (3.8%) and *Ginkgo biloba* (3.6%) [19^{¶¶}]. Below, several better characterized examples of herbal medicines that have caused anaphylactic reactions are explored.

ANDROGRAPHIS PANICULATA

Andrographis paniculata is used widely in both Ayurvedic medicine and traditional Chinese medicine, as both a sole agent or as an ingredient in oral and injectable forms. It is used commonly to treat fever and respiratory tract infections, though is also thought to have several immunomodulatory roles.

Sixteen anaphylactic and allergic reactions were identified from VigiBase from 2008 to 2013 [26]. From Thai national monitoring there were 197 case reports of adverse reactions, with *A. paniculata* being the sole suspect in 170 cases [27]. One hundred and six of the reported reactions had some degree of consistency with hypersensitivity reactions. There were five cases of anaphylactic shock, four cases of other anaphylactic reactions and five cases of angioedema. There was no data on how causation was determined.

In 2015, after increased reports of allergic and anaphylactic reactions, Australia's Therapeutic Goods Association responsible for regulating medicine undertook a comprehensive review into the safety of *A. paniculata* [26]. They found an increased risk of both anaphylaxis and allergic type reactions reporting 39 cases of anaphylaxis from a total of 178 reported adverse drug reactions. This was increased in preparations that used methanol to extract the herb suggesting that this method of extraction increased allergenicity. This was not restricted to a particular brand or product but caused by several different preparations.

ECHINACEA AND OTHER ASTERACEAE

Many members of the Asteraceae group of plants are used in herbal therapies. They are some of the oldest and most valued plants in herbal medicine. The group includes many species of flowering plants including *Echinacea* species, dandelion, ragweed, mugwort, golden lion and sunflower. These are used in the prevention and treatment of upper respiratory tract infections, and are regularly used in patients with asthma or allergies [28]. There is no clear evidence that *Echinacea* spp. is effective in the treatment of upper respiratory tracts infections, however, may have a slight benefit as a prophylactic agent [29].

Several cases of anaphylaxis and other immediate type hypersensitivity reactions to *Echinacea* spp. have been reported with an increased risk of allergenicity in atopic individuals [30]. Skin allergy testing of 84 patients with asthma or allergic rhinitis showed reactivity to *Echinacea* extracts in 16 subjects [30,31]. However, in a surveillance study into reported adverse drug reactions to both conventional and CAM therapies by a group of primary care

physicians looking after 50 000 patients, 18 830 patient received Asteraceae-containing remedies with only five allergic reactions reported, with no anaphylaxis. Despite the risk of sensitisation to *Echinacea* spp., the risk of adverse events appears low [32]. There were no reported cases of anaphylaxis in several trials included for analysis in a large meta-analysis [29] with no clear difference in adverse event incidence between placebo and treatment groups. Current advice from the European Drug Safety is to caution *Echinacea* spp. use in atopic and asthmatic individuals [33].

Japanese butterbur is used in the treatment of allergic rhinitis [12]. Recently, there have been several case reports of anaphylaxis from Japan with associated positive skin prick testing to butterbur and other Asteraceae group of plants [34].

BEE PRODUCT INDUCED ALLERGY

Several bee products are used in CAM therapies, including propolis, honey, bee pollen and royal jelly [35] with several anaphylactic reactions reported. The allergenicity of bee products is dependent on where the honey is made, as local plant pollen strongly contributes to allergenicity.

Propolis is contained in several products: tablets, toothpastes and lozenges and is known to cause contact dermatitis [35]. There are several reported cases of anaphylaxis [36]. The Italian national surveillance system for natural health products 2002–2007 found 18 reports of adverse reaction to propolis, 6 requiring treatment in hospital and 2 that were life threatening. Twenty-six allergens have been identified in propolis [35].

Honey is used as a medicinal product above its use as an ingredient; especially for its antimicrobial properties as a dressing on wounds [37]. There are several reports of anaphylaxis to honey [38–40]. The responsible allergens may be both proteins specific to honey, due to the large amounts of bee pollen found in honey [39,41] and in several cases to bee products [42]. Pollen from Asteraceae may also be causative in these reactions with some evidence that sensitisation may lead to more severe allergic reaction whenever ingested [41]. Venom allergens do not seem to be implicated in honey-related reactions.

GINKGO BILOBA

Ginkgo biloba leaf extracts are thought to have wide-ranging health benefits and have been cultivated for thousands of years [43]. It is predominantly thought to improve memory and cognitive function and is used in the treatment of dementia. However, meta-

analysis show trials to be unreliable and biased, with no benefit seen in the few randomized blinded trials. *Ginkgo biloba* flowers from April to May, releasing large amounts of pollen that are capable of causing allergic rhinitis and 4.7% of allergic patients in Seoul, Korea show sensitivity [43]. Several Cochrane group analyses on trials conducted with *G. biloba* do not show any increased risk of adverse events when compared with placebo. Case reports of contact dermatitis are reported, demonstrating the sensitizing capacity of several components of *G. biloba* [44]. There are several reported cases of anaphylaxis to *G. biloba* used in traditional Chinese medicine though these are not well characterised [23].

GINSENG

Panax ginseng is widely used in traditional Chinese and Korean medicines, used both alone and in combination with other medicines. It is thought to have several anti-inflammatory properties and is frequently used in cancer, asthma and allergic rhinitis. Little benefit has been shown in randomized controlled trials [45]. There have been previous case reports of allergy [46] and occupational asthma [47] and a recent case of anaphylaxis confirmed by skin testing and basophil activation testing [48]. The Shenmai injection has ginseng as its main ingredient, has been associated with several cases of anaphylaxis [49].

CONCLUSION

Allergy and anaphylaxis to CAM therapies are likely under reported. The use of CAM in asthma and allergies is widespread and several CAM therapies such as, vitamin supplementation, breathing exercises and nasal irrigation are currently in effective clinical use in conjunction with conventional therapies, with discernable benefit to patients despite the lack of strong evidence for their use.

Cases of anaphylaxis are often poorly investigated and causes are not clearly identified. They may occur due to a variety of different products, and an improvement in recent reporting has lead to better identification of allergic reactions to several of these products. Allergists who deal with drug allergy should have awareness of the prevalence of use especially in atopic and asthmatic patients who may be more prone to severe reactions. If any potential allergic reactions are identified, the allergy and immunology community can assist in assessing these patients to find more definitive causes often amongst several ingredients.

Acknowledgements

The author would like to thank Dr Martin Penagos for his advice and assistance in preparing this manuscript.

Financial support and sponsorship

None.

Conflicts of interest

There are no conflicts of interest.

REFERENCES AND RECOMMENDED READING

Papers of particular interest, published within the annual period of review, have been highlighted as:

■ of special interest

■ of outstanding interest

- Wieland LS, Manheimer E. Development and classification of an operational definition of complementary and alternative medicine for the Cochrane collaboration. *Altern Ther Health Med* 2011; 17:50–59.
- Zollman C, Vickers A. ABC of complementary medicine: what is complementary medicine? *BMJ* 1999; 319:1558–1561.
- Eisenberg DM1, Kessler RC, Foster C, *et al.* Unconventional medicine in the United States. Prevalence, costs, and patterns of use. *N Engl J Med* 1993; 328:246–252.
- Fan TP, Deal G, Koo HL, *et al.* Future development of global regulations of Chinese herbal products. *J Ethnopharmacol* 2012; 140:568–586.
- Kessel KA, Lettner S, Kessel C, *et al.* Use of complementary and alternative medicine (CAM) as part of the oncological treatment: survey about patients' attitude towards CAM in a university-based oncology center in Germany. *PLoS ONE* 2016; 11:e0165801.
- Wu CH, Wang CC, Tsai MT, Huang WT. Trend and pattern of herb and supplement use in the United States: results from the 2002, 2007, and 2012 national health interview surveys. *J Evid Based Complementary Altern Med* 2014; 2014. Article ID 872320. Available on line at: <http://dx.doi.org/10.1155/2014/872320>.
- Niggemann B1, Grüber C. Side-effects of complementary and alternative medicine. *Allergy* 2003; 58:707–716.
- Posadzki P, Watson LK, Alotaibi A. Prevalence of use of complementary and alternative medicine (CAM) by patients/consumers in the UK: systematic review of surveys. *Clin Med* 2013; 13:126–131.
- Clarke TC, Black LI, Stussman BJ. Trends in the use of complementary health approaches among adults: United States, 2002–2012. *Natl Health Stat Report* 2015; 1–16.
- Trends and prevalence of CAM use in a large survey of the population. Less biased than previous research to determine prevalence.
- Organization W: WHO guidelines on safety monitoring of herbal medicines in pharmacovigilance systems. World Health Organisation; 2004. 82 pp. Available online at: <http://apps.who.int/medicinedocs/documents/s7148e/s7148e.pdf>
- Harris PE, Cooper KL, Relton C. Prevalence of complementary and alternative medicine (CAM) use by the general population: a systematic review and update. *Int J Clin Pract* 2012; 66:924–939.
- Silvers WS, Bailey HK. Integrative approach to allergy and asthma using complementary and alternative medicine. *Ann Allergy Asthma Immunol* 2014; 112:280–285.
- Schäfer T. Epidemiology of complementary alternative medicine for asthma and allergy in Europe and Germany. *Ann Allergy Asthma Immunol* 2004; 93:S5–S10.
- Land MH, Wang J. Complementary and alternative medicine use among allergy practices: results of a nationwide survey of allergists. *J Allergy Clin Immunol Pract* 2017. Mar 25. pii: S2213-2198(17)30031-4, in press.
- Evidence from allergy and asthma practitioners with knowledge of CAM. Clinically useful evidence.
- Posadzki P, Watson L, Ernst E. Contamination and adulteration of herbal medicinal products (HMPs): an overview of systematic reviews. *Eur J Clin Pharmacol* 2013; 69:295–307.
- Liu SH, Chuang WC, Lam W, *et al.* Safety surveillance of traditional Chinese medicine: current and future. *Drug Saf* 2015; 38:117–128.
- Methods to improve safety of largest group of potential therapies that cause anaphylaxis; traditional Chinese medicine.
- Wiesener S, Falkenberg T, Hegyi G, Hök J. Legal status and regulation of complementary and alternative medicine in Europe. *Forsch Komplementmed* 2012; 19:29–36.
- Zhang L, Yan J, Liu X, *et al.* Pharmacovigilance practice and risk control of traditional Chinese medicine drugs in China: current status and future perspective. *J Ethnopharmacol* 2012; 140:519–525.
- Pokladnikova J, Meyboom R, Meincke R. Allergy-like immediate reactions with herbal medicines: a retrospective study using data from Vigibase® [internet]. *Drug Saf* 2016; 39:455–464.
- Data from the largest worldwide database into herbal medicines' adverse events to identify the nature of events and potential culprits. Data collected has already had impacts on the evaluation of safety of several herbal products.
- Jou J, Johnson PJ. Nondisclosure of complementary and alternative medicine use to primary care physicians: findings from the 2012 National Health Interview Survey [internet]. *J Am Med Assoc Intern Med* 2016; 176:545–546.
- Barnes J, Mills SY, Abbot NC. Different standards for reporting ADRs to herbal remedies and conventional OTC medicines: face-to-face interviews with 515 users of herbal remedies. *Br J Clin Pharmacol* 1998; 45:496–500.
- Wang L, Cheng L, Yuan Q, Cui X. Adverse drug reactions of Shuanghuanglian injection: a systematic review of public literatures. *J Evid Based Med* 2010; 3:18–26.
- Zeng ZP, Jiang JG. Analysis of the adverse reactions induced by natural product-derived drugs. *Br J Pharmacol* 2010; 159:1374–1391.
- Chan K, Zhang H, Lin ZX. An overview on adverse drug reactions to traditional Chinese medicines. *Br J Clin Pharmacol* 2015; 80:834–843.
- Listing of adverse drug reactions to traditional Chinese medicine. Lists medications that may be causative.
- George M, Topaz M. A systematic review of complementary and alternative medicine for asthma self-management. *Nurs Clin North Am* 2013; 48:53–149.
- Australian Government, Department of Health, Therapeutic Goods Administration. Safety review of *Andrographis paniculata* and anaphylactic/allergic reactions. Version 1.0, October 2015. Available online at: <https://www.tga.gov.au/sites/default/files/safety-review-andrographis.pdf>. [Accessed 4 July 2017].
- Suwankesawong W. Characterization of hypersensitivity reactions reported among *Andrographis paniculata* users in Thailand using Health Product Vigilance Center (HPVC) database. *BMC Complement Altern Med* 2014; 14:515.
- Ardjomand-Woelkart K, Bauer R. Review and assessment of medicinal safety data of orally used *Echinacea* preparations. *Planta Med* 2016; 82:17–31.
- Karsch-Völk M, Barrett B, Kiefer D, Bauer R. *Echinacea* for preventing and treating the common cold. *Cochrane Database Syst Rev* 2014; CD000530.
- Mullins RJ, Heddle R. Adverse reactions associated with *Echinacea*: the Australian experience. *Ann Allergy Asthma Immunol* 2002; 88:42–51.
- Bielory L. Adverse reactions to complementary and alternative medicine: ragweed's cousin, the coneflower (*Echinacea*), is 'a problem more than a sneeze'. *Ann Allergy Asthma Immunol* 2002; 88:7–9.
- Jeschke E, Ostermann T, Lüke C, *et al.* Remedies containing *Asteraceae* extracts: a prospective observational study of prescribing patterns and adverse drug reactions in German primary care. *Drug Saf* 2009; 32:691–706.
- European Medicines Agency Committee on herbal medicinal products (HMPC). Assessment report on *Echinacea purpurea* (L.) Moench., herba recens, EMEA/HMPC/104918/2006. Available online at: http://www.ema.europa.eu/docs/en_GB/document_library/Herbal_-HMPC_assessment_report/2009/12/WC500018261.pdf. [Accessed 4 July 2017].
- Kataoka Y, Tamagawa-Mineoka R, Masuda K, Kato N. Anaphylaxis to Japanese butterbur scapes. *Allergol Int* 2017; 66:141–142.
- Cifuentes L. Allergy to honeybee... not only stings. *Curr Opin Allergy Clin Immunol* 2015; 15:364–368.
- Hsu CY, Chiang WC, Weng TI, *et al.* Laryngeal edema and anaphylactic shock after topical propolis use for acute pharyngitis. *Am J Emergency Med* 2004; 22:432–433.
- Jull AB, Rodgers A, Walker N. Honey as a topical treatment for wounds. *Cochrane Database Syst Rev* 2008; CD005083.
- Aguar R, Duarte FC, Mendes A, Bartolomé B. Anaphylaxis caused by honey: a case report. *Asia Pac Allergy* 2017; 7:48–50.
- Jagdits A, Sussman G. Anaphylaxis from bee pollen supplement. *Can Med Assoc J* 2012; 184:1167–1169.
- Choi JH, Jang YS, Oh JW, Kim CH. Bee pollen-induced anaphylaxis: a case report and literature review. *Allergy Asthma Immunol Res* 2015; 7:513–517.
- Shahali Y. Allergy after ingestion of bee-gathered pollen: influence of botanical origins. *Ann Allergy Asthma Immunol* 2015; 114:250–251.
- Bauer L, Kohlich A, Hirschwehr R, Siemann U. Food allergy to honey: pollen or bee products?: characterization of allergenic proteins in honey by means of immunoblotting. *J Allergy Clin Immunol* 1996; 97:65–73.
- Weber RW. Allergen of the month – Ginkgo. *Ann Allergy Asthma Immunol* 2012; 108:A12.
- Ji J, Ding Y, Qian G. Airborne contact dermatitis caused by the sarcotesta of *Ginkgo biloba*. *Contact Derm* 2016; 75:384–385.
- Choi J, Kim TH, Choi TY, Lee MS. Ginseng for healthcare: a systematic review of randomized controlled trials in Korean literature. *PLoS One* 2013; 8:e59978.
- Wiwanitkit V, Taungjaruwina W. A case report of suspected ginseng allergy. *Medscape Gen Med* 2004; 6:9.
- Lee J-Y, Lee Y-D, Bahn J-W, Park H-S. A case of occupational asthma and rhinitis caused by Sanyak and Korean ginseng dusts. *Allergy* 2006; 61:392–393.
- Lee J-Y, Jin HJ, Park J-W, *et al.* A case of Korean ginseng-induced anaphylaxis confirmed by open oral challenge and basophil activation test. *Allergy Asthma Immunol Res* 2012; 4:110–111.
- Guo YJ, Wang DW, Meng L, Wang YQ. Analysis of anaphylactic shock caused by 17 types of traditional Chinese medicine injections used to treat cardiovascular and cerebrovascular diseases. *Biomed Res Int* 2015; 2015:420607.