Herbal products and homeopathic medicine are alternative practices of healing based on the pharmacologically-active components of plants and their extract products. The fascination with herbal supplements, teas, homeopathic medicines, and dietary supplements has grown tremendously in the United States, from 22% to 24% in the 1990s to approximately 60% currently. Continued increases in interest and popularity are inevitable. These supplements are especially popular among patients who undergo cosmetic surgery. Many consumers seek alternatives to conventional pharmaceuticals and explore new diet fads, discovering these remedies in the process. The growing presence of herbal and homeopathic products in the United States, many of which are native to other countries, will promote their integration into the American lifestyle. Because these popular medicinal options contain “natural” characteristics, most consumers perceive them to be safe. However, there is mounting evidence of bleeding risks associated with these remedies in the perioperative population. The risk of perioperative morbidity and mortality is increased because of the intrinsic properties of these supplements and the drug interactions that can occur. The intake of certain supplements can have devastating effects on patient outcomes.

Due to increasing reports of bleeding complications linked to alternative remedies, we conducted a focused and comprehensive review of the bleeding risks associated with herbal supplements, teas, homeopathic medicine, and dietary supplements. Intraoperative and postoperative bleeding are undesirable results for plastic surgeons and their patients; therefore, factors that contribute to bleeding should be avoided whenever possible. The purpose of this review is to describe the herbal and homeopathic supplements that are most likely to increase the risk of perioperative or postoperative bleeding and to suggest recommendations for their management.

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HERBAL SUPPLEMENTS AND HERBAL EXTRACTS

Baical Skullcap Root (Scutellaria baicalensis Georgi)

Other names: Huang qin, Scutellariae radix, Chinese skullcap. Scutellaria baicalensis, better known as Chinese skullcap, is a flowering herb of the Labiatae family. It is best known for its anti-inflammatory and antineoplastic effects, and it has been utilized for centuries in China to treat irritability, dysentery, and diarrhea. Native Americans have also advocated S. baicalensis for rabies treatment, menstruation stimulation, and placenta expulsion following childbirth. This herb has been found to inhibit coagulation in rats, possibly via its flavonoids, baicalin (baicalein), and oroxylin.14

Bromelain

Plants in the pineapple family, Bromeliaceae, produce bromelain extract, which is a mixture of proteases, peroxidase, and calcium. This pineapple derivative has anti-inflammatory effects and has been utilized for treating arthritis, autoimmune disorders, and menstrual pain. Previous studies have shown that bromelain has the potential to reduce platelet aggregation, inhibit platelet prostaglandin synthesis, reduce coagulation, and slightly increase prothrombin time.15 In another study, administration of bromelain to rats induced gastric mucosal hemorrhage.17 Because of these findings, patients should be cautioned against the use of bromelain in the perioperative period, even though some physicians may recommend it for reduction of edema.18

Chinese Agrimony (Agrimonia pilosa)

Other name: Hsien-ho-t’sao (Chinese Romanization), Xian He (Chinese Romanization). Agrimonia pilosa, known as Hsien-ho-t’sao and Xian He in Chinese, is a perennial herbaceous flowering plant. In general, the stems and leaves are utilized for analgesic, antibacterial, antihemorrhagic, and anti-inflammatory effects. To remedy the symptoms of cough and sore throat, the leaves of this herb can be cooked into a meal or made into a tea. Although the hemostatic effects of A. pilosa have been described, patients should still be strongly cautioned against the perioperative use of this herb because of its potential to markedly increase the risk of bleeding. Previous studies have demonstrated marked suppression of collagen-induced platelet aggregation that resulted in increased bleeding time, plasma prothrombin time, and activated partial thromboplastin time.19

Chinese Peony (Paeonieae rubra)

Other names: Chishao (Chinese Romanization), Radix paeonieae rubra. Chinese peony, or chishao, is a flowering plant with roots and seeds that have been utilized for medicinal purposes, including treatment of inflammation, gastrointestinal upset, and spasms.20 Its bleeding risks are attributable to its glycopeptide compound, which is structurally similar to heparin.21 Although Chinese peony displays additional anticoagulant properties, fibrinolytic activity in vitro has not yet been shown.22 The potential for delayed coagulation times makes this herb contraindicated for people who plan to undergo a surgical procedure.20

Feverfew (Tanacetum parthenium)

Other names: Chrysanthemum parthenium, Pyrethrum parthenium. The term feverfew is derived from the Latin word febrifugia, which means “fever reducer.” In the past, this small bush with daisy-like flowers has been utilized for its antipyretic properties, but now it is more common for the treatment of migraines, arthritis, and digestive problems.23 Its potential function in protecting the skin against cancer has also been researched, with encouraging results.24 Feverfew extracts contain parthenolide, which reduces sulfhydryl groups on platelets and inhibits platelet aggregation.25,26 Plastic surgeons should advise patients to taper, then discontinue feverfew completely, no later than two to three weeks before surgery. Abrupt cessation of feverfew therapy can result in withdrawal symptoms such as tension headaches, insomnia, joint pain, and nervousness.27

Fritillaria Bulbs (Fritillaria cirrhosa)

Other name: Chuan Bei Mu. Fritillaria belongs to the bulbous plant family Liliaceae and includes approximately 100 species. Its bulb can be cooked and eaten or utilized for medicinal purposes, including treatment of hypertension, respiratory symptoms, and opium toxicity.28 Previous studies have found high concentrations of adenosine and thymidine in Fritillaria, which contributes to this herb’s anticoagulation and antiplatelet aggregation properties.29,30

Dan Shen (Salvia miltiorrhiza)

Dan Shen is a perennial herb with violet-blue flowers, oval leaves, and brown nuts. For centuries, it has been utilized in China to treat diseases related to atherosclerosis, such as stroke, angina pectoris, and hypercholesterolemia.31,32 Other traditional medicinal applications include the treatment of menstrual disorders, arthritis, and insomnia. Dan Shen should be avoided by patients who plan to undergo surgery, because it powerfully inhibits platelet aggregation and release by increasing intracellular cyclic adenosine monophosphate.31,32 Previous studies have shown that dan Shen enhances anticoagulation in patients concomitantly...
taking warfarin by significantly increasing the plasma concentrations of warfarin.\textsuperscript{32,34}

**Devil’s Claw (Harpagophytum procumbens)**

Other names: grapple plant, wood spider

\textit{Harpagophytum procumbens}, a plant of the sesame family, is also known as devil’s claw because of the strange appearance of its spiny fruit. Indigenous to Southern Africa, the tuberous root extract of devil’s claw has been used for centuries as an analgesic, antipyretic, and digestion aid. Osteoarthritis and other rheumatic disorders have been treated with the active ingredients of this herb, harpagoside and beta-sitosterol.\textsuperscript{35,36} An increased risk of bleeding may accompany use of devil’s claw\textsuperscript{37}; however, further studies are needed to determine the mechanism and assess dose dependence. A previous in vitro study showed that harpagoside may alter platelet function.\textsuperscript{38}

**Garlic (Allium sativum)**

Other name: ajo

Garlic is a plant bulb and a species of the onion family, Alliaceae. Although more well known for its culinary applications, garlic has been utilized throughout history for medicinal purposes. The sulfur-containing compounds in garlic, such as allicin, reduce blood pressure and serum lipid content, thereby delaying the process of atherosclerosis.\textsuperscript{39} Interestingly, this antihypertensive effect is marginal in humans.\textsuperscript{40} Garlic has also been advocated for its antiasthmatic, antipyretic, and anthelmintic effects.\textsuperscript{5} The amount of its metabolites varies according to the form (eg, extract, fresh, oil).\textsuperscript{41}

The antiplatelet aggregation effect of garlic in humans can pose a preoperative concern. The primary chemical components of garlic, ajoene and volatile oil, have been implicated in irreversibly potentiating platelet inhibitors, including prostacyclin, indomethacin, and dipyridamole.\textsuperscript{42,43} Another mechanism of action involves allicin, a powerful organosulfur compound of garlic, which inhibits the production and release of thromboxane\textsuperscript{44} and adenosine.\textsuperscript{45} In turn, platelet function is decreased within five days of oral intake.\textsuperscript{5,46} Incidences of spontaneous epidural hematoma (in an elderly man)\textsuperscript{47} and postoperative hematoma (in a facelift patient\textsuperscript{48}) have been reported; both patients had ingested excessive amounts of garlic. However, some recent studies suggest that platelet function is not compromised by garlic. Thus, additional experiments and research are warranted. Other possible adverse effects of garlic include nausea, hypotension, headache, and halitosis.

A number of studies support the avoidance of concomitant garlic usage with coagulation inhibitors (eg, warfarin, heparin, aspirin, nonsteroidal anti-inflammatory drugs).\textsuperscript{3,48} In particular, the combination of garlic and warfarin has been shown to increase the international normalized ratio and potentiate postoperative bleeding risk.\textsuperscript{49-51} A clinical trial suggested that garlic has some effect on the pharmacokinetics of acetaminophen, but the degree of severity and precise mechanism of action will require elucidation through future studies.\textsuperscript{52} Due to its hypoglycemic effect in humans, garlic should be utilized with caution by diabetic patients.\textsuperscript{52} In general, plastic surgeons should advise patients to discontinue garlic at least seven days prior to any surgery.\textsuperscript{53}

**Ginger (Zingiber officinale)**

Ginger is a tuber and the rhizome of the plant known as \textit{Zingiber officinale}. Its cultivation began thousands of years ago in China, and it is a popular remedy for nausea, gastrointestinal bloating, dyspepsia, and arthritic inflammation.\textsuperscript{56,57} Ginger has also been utilized as a stimulant, for homeostasis restoration, and to protect the body against stress.

When consumed long-term, ginger has the potential to prolong bleeding time. Its aqueous extract has been shown to be a potent inhibitor of thromboxane synthetase and platelet aggregation,\textsuperscript{58,59} particularly in its raw form.\textsuperscript{60} An in vitro study concluded that ginger and its constituents had more potent antiplatelet activity than aspirin.\textsuperscript{60} Although no drug interactions involving ginger have been reported, caution should be exercised by patients who are undergoing concurrent anticoagulation therapy. In general, ginger should not be taken in the perioperative period, because of the increased risk of hematoma and prolonged bleeding.

**Ginkgo (Ginkgo biloba)**

Other names: maidenhair tree, duck foot tree, fossil tree, \textit{yín xìng} (Chinese pinyin Romanization), \textit{ich} (Japanese Romanization), \textit{ginnan} (Japanese Romanization)

Ginkgo, also known as maidenhair tree, belongs to the Ginkgoaceae family and is native to China. For centuries, this herb had been planted and preserved by Chinese monks, but now it is also present in the United States.\textsuperscript{43} The primary health indications for ginkgo are the prevention of erectile dysfunction, peripheral intermittent claudication, and other neurological symptoms of vascular origin.\textsuperscript{61} Various studies have shown that ginkgo improves memory,
attention, and information processing. Its noteworthy ability to improve cognitive function and dementia, specifically in Alzheimer dementia, and multi-infarct dementia, has led to a substantial increase in the sales of ginkgo during the last decade. Its medicinal preparation is made from dried ginkgo leaves, and the herb is available as tablets, capsules, sublingual sprays, and tinctures and in nutrition bars.

Consumption of ginkgo supplements during the perioperative period may not be safe. Terpenoids of ginkgo extract, called ginkgolides, are potent antagonists of platelet-activating factor. These antiplatelet effects are dose dependent, long-lasting, and rapidly established after oral intake. Previous studies have shown that ginkgo increases prothrombin time and serum salicylate levels. Other potential effects of ginkgo include arterial vasodilation, arterial spasm inhibition, and erythrocyte aggregation. Case reports of spontaneous hyphema, spontaneous intracranial bleeding, and postoperative bleeding after laparoscopic surgery have resulted in valid concerns about ginkgo’s potential to cause dangerous bleeding.

Another important consideration is the potential interaction of ginkgo with other drugs. Although it is possible that the bleeding diathesis associated with ginkgo is independent of drug interactions, concomitant use with antiplatelet, anticoagulant, and nonsteroidal anti-inflammatory drugs should still be avoided. One study indicated that combining ginkgo with a thiazide diuretic can cause hypotension. Other side effects of ginkgo include headache, nausea, and diarrhea. Since the half-life of terpenoids after oral intake ranges from three to 10 hours, it is advisable for patients to discontinue ginkgo supplements 36 hours or more prior to surgery.

**Ginseng (Panax ginseng, ginseng Panax quinquefolius)**

Ginseng is a slow-growing perennial plant with fleshy roots. There are 11 species, with the major ones being Chinese/Korean ginseng (Panax ginseng) and Vietnamese ginseng (Panax vietnamensis). The less-expensive Siberian ginseng (Eleutherococcus senticosus) is not a true ginseng, because its plant is different: it contains a woody root and eleutherosides rather than ginsenosides. Ginsenosides are steroid glycosides that are responsible for the pharmacological actions of ginseng. Ginseng is promoted as an “adaptogen” (which strengthens the body’s immune response) and is believed to build resistance to fatigue, cancer, aging, hypertension, myocardial infarctions, and infections. The herb is sold as capsules, powdered root, extract, and tincture. Ginseng is associated with an increased risk of prolonged perioperative bleeding. Ginsenosides reduce the production of thromboxane and inhibit platelet-activating factor, thereby inhibiting platelet aggregation. In vitro and animal studies have demonstrated prolonged coagulation times involving thrombin and thromboplastin and a greater potency when the ginseng was steamed. In one case, postmenopausal bleeding was attributed to the estrogen-like effect of topical ginseng. Thus, caution is needed when ginseng is taken concomitantly with anticoagulation and anti-inflammatory pharmaceuticals. In particular, concomitant use of ginseng with warfarin or aspirin should be avoided.

**Japanese Honeysuckle (Lonicera japonica)**

Other names: Suikazura (Japanese Romanization), Ren dong teng, Jinyinhu, Er Hua, Shuang Hua, Geumeunhw, Yin Qiao San

*Lonicera japonica* is a honeysuckle plant with double-tongued, sweetly-scented flowers and dark-blue berries. Traditionally, this Chinese herbal product has treated flu-like symptoms, inflammation, and ulcers. The risk of postoperative bleeding is increased with this herb because its polyphenolic compounds inhibit platelet activation.

**Liquorice/Licorice (Glycyrrhiza glabra)**

Liquorice is the root of a perennial legume, *Glycyrrhiza glabra*, and has been utilized to reduce inflammation and heal oral and peptic ulcers. The root’s extract, glycerrhizin, has been suggested as an adjunctive treatment for cancer therapy, arthritis, and renal function protection. Plastic surgeons may encounter patients who take liquorice to treat hyperpigmentation because of its tyrosinase-inhibitor activity. However, if consumed in excess, this herb can produce hypokalemic paralysis and hypertension. Although bleeding complications with liquorice have been rare, it has been associated with hemorrhagic gastritis in a child who ingested excessive amounts for a prolonged period.

**Oil of Wintergreen (Methyl Salicylate)**

Wintergreen refers to plants of the *Gaultheria* genus. Oil of wintergreen, which has a sweet aroma, is produced from these shrubs and applied topically to treat arthritis, joint discomfort, hypertension, inflammation, and cellulite. It is also a flavoring ingredient for candy, chewing gum, and toothpaste. An increased risk of bleeding may occur with topical application of methyl salicylate. Proposed mechanisms, following the absorption through the skin, include alteration of vitamin K metabolism, inhibition of platelet aggregation, and displacement of warfarin from its binding.
sites. It has been reported that one fluid ounce of wintergreen oil has the same potency and effect as 55.7 g of aspirin. In a young female patient, an extremely high international normalized ratio (12.2) was observed eight days after methyl salicylate cream was applied to her knees.

**Poncitrin (Poncirus trifoliata)**

Other name: *jishi*

_Poncirus trifoliata_, better known as *jishi* to Asian populations, is a deciduous plant that produces bitter oranges. Its thorns, bark, and fruit have been utilized as an expectorant, laxative, antidiarrheal, and antispasmodic. Postoperative bleeding is a risk in patients taking poncitrin as supplements or herbal foods. An animal study demonstrated that this herb inhibits platelet aggregation, thromboxane $A_2$ synthesis, and thrombin-induced release of adenosine triphosphate.

**Red Chili Pepper (Capsaicin)**

Red chili peppers grow from plants of the _Capsicum_ genus. Capsaicin is the active chemical of these peppers and has been proposed to relieve pain from chronic neuropathy29 and arthritis.30,31 The antipruritic effects of capsaicin for relief of uremic pruritus also have been described.32 Capsaicin can be ingested orally or applied topically as an ointment, dermal patch, or cream. With respect to bleeding, research results have been inconsistent. Some have concluded that capsaicin has a role in inhibiting platelet aggregation99 and release, whereas others suggest that it prevents hemorrhagic gastric damage in rats.100

**Saw Palmetto (Serenoa repens, Sabal serrulata)**

Saw palmetto is an extract from a berry of the _Palmae_ family. It has been advocated to treat the symptoms of mild to moderate benign prostatic hyperplasia. Side effects typically are mild and include gastrointestinal symptoms (eg, nausea, vomiting, diarrhea), rhinitis, decreased libido, and headache. In one case, saw palmetto intake was linked to severe intraoperative hemorrhage after resection of a meningioma.101 Thus, discontinuation is advised by two to three weeks before surgery.102

**HERBAL FORMULAS**

**Bak Foong Pill**

Other name: Bai Feng Wan

_Bak Foong Pill_ (BFP; Eu Yan Sang, China) is an over-the-counter traditional Chinese preparation of crude drugs, consisting of 26 ingredient herbs. BFP has been helpful in the treatment of gynecological disorders and has been suggested to improve gastrointestinal and cardiovascular function. The anticoagulant effects of BPF have been demonstrated, including prolongation of dose-dependent thrombin time (possibly due to direct thrombin inhibition), prothrombin time, and activated partial thromboplastin time. BFP and its extracts inhibit platelet aggregation with varying potencies and have demonstrated prolonged bleeding times in mice.

**Guilinggao**

Other names: tortoise jelly, turtle jelly, essence of tortoise shell

Also known as the “essence of tortoise shell,” *guilinggao* is a popular Chinese herbal product that purportedly improves skin complexion and reduces “body heat.” *Guilinggao* is made primarily from the powdered shell of rare turtles and comes in several brands, each with its own combination of herbs. Consumers often regard this product as an herbal food rather than a supplement or herbal remedy. *Guilinggao* brands include _chuarbeimu_ or _beimu_ bulbs (_Fritillaria cirrhosa_), which contain adenosine and thymidine, inhibiting platelet aggregation. Other inhibitors of platelet function are _Lonicera japonica_ and poncitrin seeds, two herbs found in some preparations of *guilinggao*. _Guilinggao_ also may contain Chinese peony roots, which have a glycopeptide similar in structure to heparin and display anticoagulant effects. An interaction with warfarin has been observed, making it especially important for surgeons to know precisely which supplements and herbal foods are being consumed by their patients.

**Kangen-karyu**

_Kangen-karyu_ (KGK) is a traditional Chinese herbal medicine consisting of six known herbs: peony root, cnidium rhizome, safflower, cyperus rhizome, saussurea root, and dan shen root. It is advocated for the treatment of hypertension, arteriosclerosis, memory impairment, and headache because it potentially reduces blood viscosity and improves microcirculation. An antithrombotic mechanism, antiplatelet effect, and synergistic relationship of KGK with warfarin have been described, which necessitate its avoidance with anticoagulant therapy. KGK also has the potential to enhance the antithrombotic effects of ticlopidine, which can increase the risk of thrombotic thrombocytopenic purpura.
prothrombin time and partial thromboplastin time and significantly decreased quantities of clotting factors V, VII, IX, and X. Inquiring specifically about the ingestion of any tea will help plastic surgeons screen for possible bleeding risks.

**Te Gastronol**

*Te gastronol* is an herbal tea manufactured in Mexico that is recommended to remedy ulcers and inflammation of the gastrointestinal tract. This herbal concoction contains a number of ingredients, one of which is Mexican *Arnica* (*Heterotheca inuloides*). Not unlike other types of *Arnica*, this ingredient poses bleeding risks to perioperative patients owing to its profound antiplatelet effect. An extensive intra-abdominal hematoma occurred in a 49-year-old man who was on no medications or supplements other than a gallon of *te gastronol* daily. This case demonstrates the importance of plastic surgeons’ awareness of everything in their patients’ diets—even teas.

**HOMEOPATHIC MEDICINES AND OTHER DIETARY SUPPLEMENTS**

**Arnica montana**

Other names: leopard’s bane, wolf’s bane, mountain tobacco, mountain arnica

*Arnica montana* is a plant with large yellow flowers that is endemic to Europe. It has been utilized to treat osteoarthritis and minor orthopedic injuries. There are two general forms of *A. montana*: herbal preparations and homeopathic medicines. The amount of plant extract is substantially higher in the herbal form, and most adverse effects have been associated with herbal preparations.

Some surgeons have recommended homeopathic *A. montana* to aid in the reduction of perioperative swelling. However, this should be done with caution because constituents of *A. montana* have been found to inhibit human thromboxane formation and collagen-induced platelet function. Employing cautionary measures appears to optimize the utility of homeopathic *A. montana* for swelling while minimizing the risk of intraoperative bleeding. One study showed that *A. montana* had no preventive effect on postoperative hematomas for saphenous stripping. Potentiation of warfarin therapy has been found to be a quality of *A. montana*, making it unadvisable to combine this herb with warfarin. Caution is also recommended with topical *A. montana*, which should not be applied to any surgical incisions or broken skin.

**Chondroitin and Glucosamine**

Chondroitin and glucosamine are glycosaminoglycans that are often sold and taken together as supplements for cartilage repair. Previous studies have demonstrated moderate efficacy in delaying the progression of osteoarthritis. Although plastic surgeons may not necessarily have patients discontinue these popular supplements due to their benefit, they should be aware of the increased bleeding potential. Chondroitin and heparin share a similar chemical composition, leading researchers to speculate that the chondroitin may increase the risk of perioperative bleeding. In a previous study, when glucosamine was given to guinea pigs, it strongly inhibited platelet aggregation, adenosine triphosphate release, and thromboxane A₂ synthesis. Also of perioperative concern is the fact that glucosamine contains a plant peptide that may mimic human insulin and cause hypoglycemia. It is important to note that although chondroitin and glucosamine may cause perioperative bleeding, plastic surgeons may need to balance this detriment with the analgesic benefits.

**Fish Oil (Eicosapentaenoic Acid)**

Eicosapentaenoic acid, better known as fish oil, has been rapidly growing in popularity because of its beneficial effects in preventing cardiovascular diseases. However, previous studies have shown its great potential to prolong bleeding and increase the risk of postoperative hematomas in patients who take this popular supplement. Decreased thromboxane A₂ production, prolonged bleeding time, and decreased platelet aggregation through inhibition of the ADP pathway have been shown to be dose-dependent mechanisms of fish oil in animals and humans.

**Vitamin E**

Vitamin E has become very popular for cancer prevention as well as its antioxidant and antiatherosclerosis effects. However, findings from human and animal studies are contradictory about the bleeding risk associated with this vitamin.

Increased bleeding tendency via inhibition of the intrinsic coagulation pathway and thrombin-induced platelet aggregation has been demonstrated in animal and human studies of vitamin E supplements. Another study showed that the kiwi fruit’s ability to inhibit platelet activity is attributable to its high content of vitamin C, vitamin E, and polyphenols. However, a different study showed no changes in coagulation measures or platelet aggregation and concluded that perioperative discontinuation of vitamin E is unnecessary. Therefore, it is clear that additional studies in humans are needed to determine whether a positive association indeed exists between vitamin E and bleeding risk. In the meantime, guidelines set forth by the Institute of Medicine can be employed, which suggest that a dose of 1000 mg daily is safe. It is important to note that any amount in excess of this may interfere with vitamin K metabolism, thereby delaying coagulation. Some have recommended that vitamin E not be resumed until the healing phase is complete.
DISCUSSION

The growing popularity of herbal and homeopathic supplements in the last two decades has led to increased examination, which has called into question the safety of these products. It is tempting for physicians and patients to assume that these remedies are safe because they are touted for their “natural” characteristics. Although alternative medicine products are strictly regulated in countries such as Germany and Australia, there is no similar set of laws regarding their use or sale in the United States. The Dietary Supplement Health and Education Act of 1994 classified herbs and dietary supplements as “foods” and exempted them from the safety and efficacy requirements that “drugs” must fulfill. Unfortunately, the absence of direct regulation of the US Food and Drug Administration on herbs as drugs translates to a lack of standardization that physicians and patients would not normally expect from medicine. There is little assurance of predictable potencies, proper identification of plants, contamination control, and accurate labeling from manufacturers. Thus, it has become important for physicians to screen patients and educate them on purchasing their supplements from countries that have codes of manufacturing for these herbal products.

In addition to the lack of regulation of dietary supplements in the United States, Americans have limited knowledge of herbal and homeopathic medicines, which represents yet another safety concern. Typically, the properties of alternative medicines are not taught as part of the US health care education, nor are they implemented into standard hospital patient care. A previous study showed that surgeons were not able to identify side-effect profiles for 90% of the medicinal supplements listed. Lack of knowledge about patients’ medicinal intake can be extremely dangerous, especially in a surgical setting with anesthesia and bleeding risks. Studies have shown that, even when screening is conducted, up to 70% of patients do not disclose their use of these agents, which may lead to devastating consequences for surgeons and their patients.

Reports of perioperative complications associated with herbal supplements are not uncommon. A possible factor contributing to the increased morbidity may be the variable quality of commercially-processed extracts. In an investigation by the Food and Drug Branch of the California Department of Health Services, toxic levels of lead, arsenic, and mercury were found in nearly one third of Asian patent herbal products sold in California retail herbal stores. Ideally, patients who take herbal supplements would be supervised by a medical professional with proper training in herbal medicine, but this is often impossible because the supplements are available over the counter and their proposed health indications can be easily researched online via unregulated websites. Therefore, it is the physician’s responsibility to accurately and adequately screen their patients before performing any invasive procedure or even managing the medications. Table 1 contains a list of questions that can aid in the screening process.

Table 1. Questions to Ask Patients During Screening for Herbal/ Homeopathic Medicine Use

<table>
<thead>
<tr>
<th>Question</th>
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<tbody>
<tr>
<td>1. Are you currently taking any of the following: an herbal product, herbal supplement, tea, herbal food, or other “natural remedies”?</td>
</tr>
<tr>
<td>2. Have you taken any herbal or homeopathic supplements in the past?</td>
</tr>
<tr>
<td>3. In the past four weeks, what types of tea have you consumed?</td>
</tr>
<tr>
<td>4. In the past four weeks, what types of vegetables and plant products have you eaten?</td>
</tr>
<tr>
<td>5. Are you taking any dietary supplements or vitamins?</td>
</tr>
<tr>
<td>a. How long have you been taking it?</td>
</tr>
<tr>
<td>b. Who prescribed it for you or recommended it to you?</td>
</tr>
<tr>
<td>6. In the past four weeks, have you taken any pills, medications, or supplements that were purchased on the Internet?</td>
</tr>
<tr>
<td>7. What other medications are you taking?</td>
</tr>
</tbody>
</table>

Table 2. Coumarin-Containing Supplements

<table>
<thead>
<tr>
<th>Supplement</th>
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</thead>
<tbody>
<tr>
<td>Alfalfa (Medicago sativa)</td>
</tr>
<tr>
<td>Fenugreek (Trigonella foenum-graecum)</td>
</tr>
<tr>
<td>Red clover (Trifolium pratense)</td>
</tr>
<tr>
<td>Sweet clover (Mellilotus officinalis, Mellilotus alba)</td>
</tr>
<tr>
<td>Sweet woodruff (Galium odoratum)</td>
</tr>
</tbody>
</table>

Numerous studies have shown enhanced effects of anticoagulants when combined with herbal and homeopathic supplements. However, we did not focus on these effects during the present review because plastic surgeons generally do not perform elective operations on patients with conditions that warrant such therapies. Instead, we discussed remedies that increase the risk of intrinsic bleeding, which can result in serious problems for plastic surgeons and their patients. For example, a hematoma after an elective facelift can cause flap necrosis and a catastrophic result. Some herbal medicines contain coumarins (Table 2), and their plants are similar in structure to warfarin. Others inherently possess significant pharmacologic activity to antagonize normal platelet aggregation and coagulation mechanisms (Figure 1).

For herbal and homeopathic medications that lack pharmacokinetic data, the American Society of Anesthesiologists recommends that these treatments be discontinued two to three weeks preoperatively. For unfamiliar herbal and dietary supplements, we take additional precautions by asking that patients not resume use of the supplement for one to two weeks postoperatively. However, plastic surgeons should treat each patient on an individual basis. If a patient truly benefits from a particular supplement (eg, for pain control) and the risk of perioperative bleeding is relatively minimal, it may be reasonable to allow for its continuation. These recommendations are detailed further in Table 3.
Figure 1. Proposed antiplatelet aggregation and anticoagulation mechanisms of herbal teas, homeopathic medicines, and dietary supplements.
## Table 3. Herbs, Herbal Teas, Homeopathic Medicines, and Dietary Supplements Associated With an Increased Risk of Bleeding

<table>
<thead>
<tr>
<th>Supplement Names</th>
<th>Conditions Treated</th>
<th>Published Evidence of Increased Bleeding Risk</th>
<th>Other Side Effects (In Addition to Intrinsic Bleeding Risks)</th>
<th>Perioperative Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Herbs and herbal extracts</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Garlic Allium sativum Ajo</td>
<td>Hypertension, hypercholesterolemia, fungal infections, cancer, MI prevention, PVD</td>
<td>Animal study: platelet aggregation inhibition</td>
<td>Nausea, vomiting, hypoglycemia, halitosis, potential of warfarin, increased INR, abdominal pain, diarrhea, oral ulcers, anaphylaxis (rare)</td>
<td>Discontinue seven days preoperatively. Resume seven days postoperatively.</td>
</tr>
<tr>
<td>Ginger Zingiber officinale</td>
<td>Nausea, vomiting, GI bloating, dyspepsia, OA, RA, migraine, homeostasis restoration, weight loss</td>
<td>In vitro: platelet aggregation inhibition</td>
<td>Nausea, GI bloating, hypoglycemia, possible arrhythmia, worsens cholecystitis</td>
<td>Discontinue two to three weeks preoperatively. Resume two weeks postoperatively.</td>
</tr>
<tr>
<td>Ginseng Panax ginseng</td>
<td>Stimulant, cancer prevention, CAD, DM2, dyspepsia, colic, infections, aging, stress, homeostasis restoration</td>
<td>In vitro: platelet aggregation inhibition</td>
<td>Nausea, diarrhea, headaches, blood pressure changes, breast tenderness, hypoglycemia, possible insomnia, interaction with warfarin</td>
<td>Discontinue seven days preoperatively. Resume two weeks postoperatively.</td>
</tr>
<tr>
<td>Ginkgo Ginkgo biloba Maidenhair tree</td>
<td>Circulatory stimulant, dementia (Alzheimer’s, multi-infarct), memory enhancement, PVD, ED</td>
<td>Case report: post-laparoscopic cholecystectomy bleeding</td>
<td>Nausea, vomiting, diarrhea, GI discomfort, palpatations, potentiates warfarin</td>
<td>Discontinue 36 hours or more preoperatively. Resume seven days postoperatively.</td>
</tr>
<tr>
<td>Feverfew Tanacetum parthenium</td>
<td>Fever, migraine, OA, GI upset, infertility</td>
<td>In vitro: inhibited human platelet aggregation</td>
<td>Oral ulcers, allergic reactions, GI discomfort and bloating</td>
<td>Taper and discontinue by two to three weeks preoperatively to avoid withdrawal syndrome with abrupt cessation. Resume two weeks postoperatively.</td>
</tr>
<tr>
<td>Bromelain</td>
<td>Inflammation, OA, autoimmune disorders, menstrual pain, digestion, goit</td>
<td>Human study: slight prolonged coagulation and PT</td>
<td>GI discomfort, diarrhea, tachycardia, possible menorrhagia</td>
<td>Discontinue two to three weeks preoperatively. Resume two weeks postoperatively.</td>
</tr>
<tr>
<td>Liquorice/Licorice Glycyrrhiza glabra</td>
<td>Aphthous ulcers, peptic ulcers, cancer, OA, adrenal insufficiency</td>
<td>Case report: hemorrhagic gastritis</td>
<td>Hypokalemic paralysis, hypertension, weight loss/gain, infertility, temporary vision loss</td>
<td>Discontinue two to three weeks preoperatively. Resume two weeks postoperatively.</td>
</tr>
<tr>
<td>Red chili pepper Capsaicin</td>
<td>Analgesic, chronic neuropathy, OA, uremic pruritus, psoriasis</td>
<td>In vitro: reduced clotting factor VIII:C activity</td>
<td>Burning and stinging on contact, hypoglycemia, cough</td>
<td>Discontinue two to three weeks preoperatively. Resume two weeks postoperatively.</td>
</tr>
<tr>
<td>Saw palmetto Serenoa repens</td>
<td>Benign prostatic hyperplasia, urinary tract infections</td>
<td>Case report: hematuria, coagulopathy</td>
<td>Nausea, vomiting, diarrhea, rhinitis, decreased libido, headache</td>
<td>Discontinue two to three weeks preoperatively. Resume two weeks postoperatively.</td>
</tr>
<tr>
<td>Oil of wintergreen Methyl salicylate</td>
<td>OA, joint discomfort, hypertension, inflammation, cellulite, flavoring agent</td>
<td>Case series: bruising, GI bleeding, elevated INR from drug interaction with warfarin</td>
<td>Displaces warfarin, nausea, vomiting, dizziness, increased INR</td>
<td>Discontinue two to three weeks preoperatively. Resume two weeks postoperatively.</td>
</tr>
<tr>
<td>Devil's claw Harpagophytum procumbens</td>
<td>Analgesic, fever, digestion aid, OA, appetite stimulant</td>
<td>In vitro: inhibition of COX-1 and COX-2</td>
<td>Diarrhea, GI discomfort, tinnitus, headache, hypoglycemia, possible arrhythmia</td>
<td>Discontinue two to three weeks preoperatively. Resume two weeks postoperatively.</td>
</tr>
<tr>
<td>Chinese agrimony Agrimonia Pilosa Hsien-Ho-T‘sao</td>
<td>Analgesic, bacterial infection, helminthic infection, diarrhea, inflammation, cough, sore throat</td>
<td>Animal study: inhibited platelet aggregation</td>
<td></td>
<td>Discontinue two to three weeks preoperatively. Resume two weeks postoperatively.</td>
</tr>
</tbody>
</table>

(continued)
Table 3. (continued)

<table>
<thead>
<tr>
<th>Supplement Names</th>
<th>Conditions Treated</th>
<th>Published Evidence of Increased Bleeding Risk</th>
<th>Other Side Effects (in Addition to Intrinsic Bleeding Risks)</th>
<th>Perioperative Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dan shen</td>
<td>Atherosclerosis, stroke, angina pectoris, hypercholesterolemia, cancer, HIV, menstrual disorders, OA, insomnia, prostatitis</td>
<td>Animal study: inhibited platelet aggregation</td>
<td>Hypotension, GI discomfort, reduced appetite, pruritus, possible seizures, potentiates warfarin</td>
<td>Discontinue two to three weeks preoperatively. Resume two weeks postoperatively.</td>
</tr>
<tr>
<td>Salvia miltiorrhiza</td>
<td>Anxiety, inflammation, cancer, seizures, infections, insomnia, dysentery, diarrhea, rashes, menstrual disorders</td>
<td></td>
<td>Hepatotoxicity, pneumonitis</td>
<td>Discontinue two to three weeks preoperatively. Resume two weeks postoperatively.</td>
</tr>
<tr>
<td>Baical skullcap root</td>
<td>Anxiety, inflammation, cancer, seizures, infections, insomnia, dysentery, diarrhea, rashes, menstrual disorders</td>
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<tr>
<td>Scutellaria baicalensis</td>
<td>Animal study: inhibited platelet aggregation</td>
<td></td>
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<tr>
<td>Geum japonicum</td>
<td>Diuretic, astringent, CAD, hypercholesterolemia</td>
<td>In vitro: anticoagulant (prolonged PT, TT, PTT)</td>
<td></td>
<td>Discontinue two to three weeks preoperatively. Resume two weeks postoperatively.</td>
</tr>
<tr>
<td>Chinese peony</td>
<td>Inflammation, GI discomfort, spasm</td>
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<tr>
<td>Paeoniae rubra</td>
<td>Constipation, diarrhea, spasm, expectorant</td>
<td>In vitro: inhibited platelet aggregation</td>
<td></td>
<td>Discontinue two to three weeks preoperatively. Resume two weeks postoperatively.</td>
</tr>
<tr>
<td>Poncitrin</td>
<td>Spasm, expectorant, hypertension, cough, asthma, opium toxicity</td>
<td></td>
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<tr>
<td>Poncirus trifoliata</td>
<td>In vitro: isolated compounds inhibited platelet activation</td>
<td></td>
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<td></td>
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<tr>
<td>Fritillaria</td>
<td>Fever, headache, cough, sore throat, bacterial infection, inflammation, ulcers</td>
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<td>Fritillaria cirrhosa</td>
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<td>Japanese honeysuckle</td>
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<td>Lonicera japonica</td>
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<tr>
<td>Herbal formulas</td>
<td>Kangen-karyu</td>
<td>Hypertension, arteriosclerosis, memory impairment, headache</td>
<td>Animal study: inhibited platelet aggregation</td>
<td></td>
</tr>
<tr>
<td>Bak Foong Pill</td>
<td>GI disturbances, cardiovascular disturbances, gynecological dysfunction</td>
<td>Animal study: inhibited platelet aggregation, anticoagulant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Herbal teas</td>
<td>Te gastronol</td>
<td>GI ulcers, intestinal inflammation, colitis, gastritis, flatulence</td>
<td>Case report: GI bleeding</td>
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<tr>
<td>Seasonal tonic</td>
<td>Appetite suppressant</td>
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<tr>
<td>Homeopathic medicines and other dietary supplements</td>
<td>Guilinggao</td>
<td>Fever, acne, enhancing circulation, improve intestinal function, constipation</td>
<td>Case report: mucosal bleeding, epistaxis, bruising, elevated INR with concomitant warfarin</td>
<td></td>
</tr>
<tr>
<td>Tortoise jelly</td>
<td>Peyronie’s disease, bladder cancer prevention, RA, Alzheimer’s disease, premenstrual syndrome, movement disorders</td>
<td>Case series: bleeding diathesis, prolonged PT and PTT</td>
<td>Allergic reaction, fatigue, weakness, headache, nausea, diarrhea, vision disturbance, congenital heart defects in utero, heart failure</td>
<td></td>
</tr>
<tr>
<td>Vitamin E</td>
<td>OA, sprains, joint pain, inflammation</td>
<td>In vitro: constituents inhibited platelet function</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arnica montana</td>
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</tbody>
</table>
A summary of the most popular herbs with potentially dangerous bleeding effects is provided in Table 4. It is essential that plastic surgeons be aware of these products. When counseling patients preoperatively, surgeons should explain the reasons for discontinuing these supplements at the recommended times, as well as the potential complications they pose both intraoperatively and postoperatively. Prior to surgery, we provide each patient with a list of supplements that require cautionary use or complete discontinuation. A great deal of future research will be required to fully understand the in vitro and in vivo effects of herbs as well as their pharmacodynamics with other medications, but the list provided in this article serves as an outline of our current knowledge and recommendations.

**CONCLUSIONS**

Well-controlled clinical trials may validate ancient remedies or yield valuable information about new and existing herbal medicines. For now, one of the best and safest methods of preparing patients for surgery is to adequately screen them for use of any herbal foods, supplements, teas, and other homeopathic remedies—many of which may increase the risk and duration of bleeding. This is especially important in the plastic surgery realm because the prevalence of herbal medicines is greater among the cosmetic surgery population relative to the general population. In addition to being aware of the adverse effects of these supplements and to screening patients appropriately, surgeons must educate patients on the potential complications of these treatments and manage their use effectively so that optimal surgical results can be achieved.

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