The use of herbal medicine dates back at least several thousand years in both China and India. In Western cultures, alternative (non-allopathic) medicine had historically been the most prominent and accessible form of health care for the general population before the twentieth century. The earliest of Hippocratic teachings, *The Healing Power of Nature* (*Vis Medicatrix Naturae*), is the basis of naturopathic medicine. In North America, alternative medicine can be traced back to the teachings of Dr. Benedict Lust, founder of the American School of Naturopathy, which graduated its first class in 1902. The advent of advanced diagnostic technologies, surgical techniques, and highly effective pharmaceutical intervention during the era of the Second World War increased the popularity of conventional allopathic medicine. During this period, naturopathic medicine slowly receded into the background of diagnostic science and medicine.

Alternative medical therapies have grown exponentially in prevalence and importance within the United States healthcare system in the last 20 years. In 1997 alone, an estimated $27 billion was spent on alternative therapies, an amount comparable with the out-of-pocket expenditures for all United States physician services in 1997. With this increasing popularity of alternative and complementary therapies, the remaining schools teaching naturopathic medicine flourished. In North America there are currently fully accredited naturopathic medical schools and two other medical schools currently in the process of accreditation.

**DISPENSING OF HERBAL SUPPLEMENTS**

Complementary medicines are widely available at many pharmacies, health food stores, and doctors’ offices. Naturopathic doctors, practitioners of Chinese medicine, and licensed herbalists prescribe and dispense herbal products in a variety of formulations, including tinctures, herbal powders, and standardized extracts.

The greatest issues with respect to the dispensing of these medications involve quality control and ease of access. There is very little in the way of third-party independent laboratory testing for most companies making alternative medications, yet there are companies that operate under “good manufacturing practice” (GMP) standards (see below) and regularly have their product(s) tested, ensuring both quality and dosage. The ease of access to these products without prescriptions and the relative laxity in terms of medication claims increases not only the possibility of ineffective or dan-
gerous dosing, but also drug-medication-supplement interaction and possible allergen response.

**SURGICAL RELEVANCE OF HERBAL SUPPLEMENTS**

Patients tend to underreport the use of complementary medicines to their conventional health care providers. In fact, 40% to 70% of responders in many investigations did not report complementary medicine use to their doctors.\(^3\)\(^5\) In contrast, almost all (90.9%) of patients seeking care from a naturopathic physician discuss their prescription medications.\(^4\) There are many reasons for this phenomenon. Many patients feel that their physician will not understand, approve of, or have interest in such modalities. Others may feel that their physician has little knowledge about these products, may not consider the dietary supplements to be medications, or feel that the supplements are not related to their current medical care.\(^6\)\(^7\) However, it is paramount that the physician address each patient’s herbal supplement regimen.

When undergoing plastic surgery procedures, the most significant and potentially deleterious effects of alternative medicines occur within the perioperative period. In considering the dizzying array of supplements available, the main concerns of the plastic surgeon are interaction with other medications, cardiovascular effects, alteration of coagulation, and sedative effects. One survey of surgical patients revealed that 42.7% of patients took alternative medicines in the 2 weeks before surgery, including some with cardiovascular, coagulation, and sedative effects.\(^8\)

Here, we attempt to list the most clinically relevant alternative medications, both positive and negative, with the goal of preventing adverse outcomes and potential side effects during the perioperative period. An additional goal is to increase physician knowledge of a socially and medically significant phenomenon that may potentially impact patients in a plastic surgery setting. By working with trained naturopathic physicians, side effects during the perioperative period may be avoided and wound healing may potentially be enhanced (Table 1).

**CLINICALLY SIGNIFICANT HERBAL SUPPLEMENTS**

**Wound Healing**

*Arnica.* *Arnica montana*—also known as leopard’s bane, wolf’s bane, mountain tobacco, and mountain arnica and sold as SinEcch (Alpine Pharmaceuticals, Boston, MA) and in a formulation by VitaMedica (Manhattan Beach, CA)—is an herbal remedy of European and Native American lineage used to treat ecchymoses and pain after traumatic injuries; it is purported to have antinflammatory, antiseptic, and vasodilatory properties.\(^10\)\(^11\) Arnica may be used topically or orally in homeopathic doses.

*Surgical relevance.* Scientific studies of Arnica have been equivocal. Positive effects on both osteoarthritis pain and postoperative inflammation have been report-

<table>
<thead>
<tr>
<th>Table 1. Alternative medicine Web sites</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://www.nccam.nih.gov">www.nccam.nih.gov</a></td>
</tr>
<tr>
<td><a href="http://www.fda.gov/consumer">www.fda.gov/consumer</a></td>
</tr>
<tr>
<td><a href="http://www.herbmed.org">www.herbmed.org</a></td>
</tr>
<tr>
<td><a href="http://www.consumerlab.com">www.consumerlab.com</a></td>
</tr>
</tbody>
</table>

A placebo-controlled study investigating the effects of Arnica on post-laser ecchymoses revealed no difference from placebo.\(^15\) In a randomized, controlled comparison of dexamethasone and Arnica administered to rhinoplasty patients, both drugs decreased edema when compared with the placebo. However, neither medication decreased ecchymoses and, in fact, ecchymoses was more intense and persistent than with steroid use.\(^16\) Arnica was also found to make no significant difference in hematoma formation after saphenous vein stripping.\(^17\)

**St. John’s wort.** St. John’s wort—known as amber, touch-and-heal, hardhay, hypericum, *Hypericum perforatum*, Klamath weed, millepertuis, rose, and Tipton’s weed—is a traditional folk remedy used to treat a variety of maladies, including anxiety and depression, and is a topical treatment for superficial wounds and burns.\(^18\) Its effects on mild depression have been confirmed; however, it is not an effective medication for treating major depression.\(^19\)\(^21\) The pharmacologic effects of St. John’s wort may be attributed to many agents, making standardization of the drug difficult.\(^22\) The mechanism of action is unknown, but in vitro evidence demonstrates the inhibition of monoamine oxidase (MAOI) and serotonin reuptake (SSRI).\(^23\)\(^25\) The clinical significance of the MAOI and SSRI effects in vivo are unknown and may be minimal, but St. John’s wort must be discontinued in patients on a regimen using either of these drug classes.

*Surgical relevance.* St. John’s wort is known to induce photosensitivity.\(^26\)\(^27\) The use of other photosensitive drugs, such as tetracycline, and treatment with laser or intense pulsed light should be avoided while patients are taking St. John’s wort. Cytochrome P4503A4 is also induced, decreasing the activity of warfarin, cyclosporine, ethinyl estradiol (oral contraceptive), digitalis, midazolam, lidocaine, and calcium channel blockers.\(^28\)\(^30\) St. John’s wort should be discontinued at least 5 days before surgery, particularly in patients who will undergo organ transplantation or need anticoagulation postoperatively.

**Bromelain.** Bromelain—also known as pineapple extract, *Ananas sativus*, ananase, bromeline, bromelainum, or traumanase—is a protease enzyme extracted from the stem of pineapples. It has been used for centuries for decreasing edema, inflammation, and pain.
Several placebo-controlled trials have shown efficacy of bromelain in resorption of hematomas and in wound healing.9,31

**Surgical relevance.** Bromelain or supplements containing bromelain may help accelerate wound healing and hematoma resorption. Theoretically, because of bromelain’s antiinflammatory properties, there may be an increased risk of bleeding; however, there are no data to support this claim.

**Echinacea.** Echinacea—also known as American coneflower, black sampson, comb flower, *Echinacea angustifolia*, hedgehog, Indian head, purple coneflower, Rudbeckia, sampson head, scurvy root, and snakeroot—is widely used throughout Europe and North America for the treatment of common colds, primarily upper respiratory tract infections. It is also used for chronic open wounds and arthritis. Echinacea’s pharmacological effects are primarily immunostimulatory; however, a single active compound has not been identified.32,33

There are different types of echinacea (*E angustifolia*, *E pallida*, and *E purpurea*), and preparations sold in the United States vary greatly. Several randomized, controlled studies have been performed, demonstrating possible beneficial effects of *E purpurea* when taken early in the treatment of colds.34

**Surgical relevance.** Because of its immunostimulatory effects, echinacea is contraindicated in patients with autoimmune disease (HIV, lupus, etc.). Prolonged (>8 weeks) use of echinacea may induce tachyphylaxis; however, the mechanism for this is unknown.35 It is also an inhibitor of cytochrome P450 3A4 and thus may potentiate toxicity of drugs metabolized by this pathway.36

**Coagulation/Cardiovascular**

**Garlic.** Garlic—also known as allium, *Allium sativum*, stinking rose, and rustic treacle—is one of the most popular supplements available. It is widely reported to have antimicrobial, immunostimulatory, and antiatherosclerotic properties.37 It has been widely investigated, primarily for its cardioprotective (hypotensive and hypcholesterolemic) effects.38 It is also commonly used by HIV-positive patients with the goal of increasing health and decreasing opportunistic infections.39

There have been several randomized, double-blind, placebo-controlled trials of garlic as a lipid-lowering agent, demonstrating moderate reductions of 4% to 6% in most studies. Other nonrandomized and noncontrolled studies have garnered more impressive results. Comparing dietary modification with statin drugs for cholesterol reduction, dietary modification alone may decrease total cholesterol by approximately 5% within 6 months, while statin drugs reduce total cholesterol by 17% to 32%.40-43

**Surgical relevance.** Garlic does seem to have significant effects on both systolic and diastolic blood pressure. Garlic powder administered to 45 nonrandomized, noncontrolled patients over a period of 12 weeks resulted in a statistically significant reduction of diastolic blood pressure (102 mmHg to 89 mmHg).44 Furthermore, a metaanalysis of 415 patients also revealed a statistically significant but marginal decrease in systolic and diastolic blood pressure.45 Garlic may also inhibit platelet aggregation in a dose-dependent fashion and may potentiate the effects of other platelet inhibitors such as warfarin, heparin, aspirin, and nonsteroidal antiinflammatory agents.46-48

**Dong Quai.** Dong Quai—also known as *Angelica polymorpha*—*A sinensis*, Chinese angelica, danggui, and tang-kuei—is an herb that predominantly has been used in Chinese medicine for centuries for its “blood boosting” properties and for female health in areas such as reducing menstrual cramps, regulating the menstrual cycle, and lessening the effects of menopause. In a randomized, double-blind, placebo-controlled trial of 71 menopausal women, Dong Quai was proven to be no different than the placebo in decreasing hot flashes or endometrial thickening.49 However, most Dong Quai prescribed for menopause is in a combination form with other herbal ingredients, making analysis of each constituent difficult.

**Surgical relevance.** Dong Quai may increase international normalized ratio, prothrombin time, and activated partial thromboplastin time.50 Photosensitivity also may occur; therefore, patients undergoing laser procedures should avoid this medication.

**Feverfew.** Feverfew—also known as featherfew, altamisa, *Chrysanthemum parthenium*, flirtwort, *Pyrethrum parthenium*, *Tanacetum parthenium*, wild chamomile, and wild quinine—is primarily used for migraine alleviation, but it is also used for common headaches and arthritis. Results of randomized, placebo-controlled, double-blind studies have been equivocal as to the effects on migraine prevention.51

**Surgical relevance.** Feverfew has been shown to inhibit platelet activity and may potentiate the effects of other anticoagulants.52,53

**Ginkgo biloba.** Ginkgo biloba—also known as Japanese silver apricot, kew tree, maidenhair tree, and yinhsing—has been used for cognitive disorders, peripheral vascular disease, age-related macular degeneration, erectile dysfunction, and vertigo. Several studies have suggested that it may stabilize or improve cognition in Alzheimer patients.54,55 Ginkgo biloba appears to act as an antioxidant, a modulator of neurotransmitter activity, and an inhibitor of platelet-activating factor.56,57

**Surgical relevance.** Ginkgo biloba is considered safe; however, in the perioperative period, its platelet inhibitory effects may be of some concern. There are several anecdotal reports of bleeding complications attributed to ginkgo biloba use, including four cases of spontaneous intracranial bleeding, spontaneous hyphema,58 and postoperative bleeding following laparoscopic cholecystectomy.

**Ephedra.** Ephedra—also known as *Ephedra sinica*, epitonin, herbal ecstasy, Ma Huang, muzei, and popptil-lo is used to promote weight loss, treat respiratory ailments (bronchitis and asthma), and increase energy. Formulations are constituted of ephedrine, pseu-
doephedrine, norephedrine, methylephedrine, and nor- pseudoephedrine. Its sympathomimetic (α1β1, β2) effects primarily cause an increase in blood pressure and heart rate. Ephedra has also been found to inhibit the complement pathway in vitro.

Surgical relevance. There are many concerns about the perioperative use of ephedra. In the United States, reactions to ephedra accounted for 64% of all adverse effects from herbal supplementation, including fatal cardiac and cerebral events. The US Food and Drug Administration (FDA) also mandated the removal of ephedra-containing products because of their risks. Patients who have used ephedra and are subsequently anesthetized with halothane gas are at an increased risk for ventricular arrhythmias because halothane sensitizes the myocardium to catecholamine effects. The possibility of coronary and cerebral vasoconstriction and/or vasospasm may lead to myocardial infarction or thrombotic stroke.

Ginseng. Ginseng—particularly the American (Panax quenfolius) and Oriental species (Panax ginseng)—is known as an “adaptogen,” having the ability to protect the body from stress and restore homeostasis. The primary constituents of ginseng are ginsenosides, a class of molecules known to act in a manner similar to steroid hormones. Ginsenosides have also been found to inhibit platelet aggregation in vitro; however, its effect in vivo has not been confirmed in humans.

Sedative Effects

Kava. Kava—also known as awa, kava kava, kew, Piper methysticum, tonga, and yagona—is one of the more popular naturopathic sedatives and anxiolytics. Its pharmacologic activity appears to be derived from kavalactones, which have a dose-dependent potentiating effect on gamma-aminobutyric acid (GABA) inhibitory neurotransmission. Several double-blind, randomized, placebo-controlled trials and one metaanalysis concluded that kava extract has significant therapeutic potential.

Surgical relevance. Kava may potentiate the effects of barbiturate and benzodiazepine sedatives. There is also the potential for abuse; however, addiction, withdrawal, and tolerance have not been investigated. Kava products have also been associated with hepatic dysfunction, including liver failure and hepatitis. The FDA has issued a warning about kava and kava has been withdrawn from the Canadian market.

Valerian. Valerian—known alternately as baldrarian, garden heliotrope, Valeriana officinalis, V sambucifolia, V wallichii, and valerian—is a sedative that is primarily used in the treatment of insomnia. Several placebo-controlled, double-blind investigations have shown significant decreases in sleep latency using valerian. Effects of valerian are mediated through GABA neurotransmission. Therefore, like kava, the potentiation of barbiturates and withdrawal symptoms may be possible, but only anecdotal evidence exists of clinical manifestations of this effect.

Surgical relevance. In the perioperative setting, patients using valerian over the long term should not discontinue it abruptly, because its withdrawal effects are unknown. In these patients, a tapering dose over a period of several weeks may be administered. The concomitant use of sedatives and anxiolytics is contraindicated.

DRUG INTERACTIONS

The interaction of herbal medications with allopathic medicines is complex. Many of the harmful interactions stem from the cytochrome P450 pathway used by many medications. Table 2 lists a summary of the herbal medications most at risk for interactions. For example, goldenseal (eyebalm, ground raspberry, or yellowroot) is a perennial herb, that is native to North America, and is often used as a multipurpose remedy with purported antimicrobial and digestive properties. It is also a potent inhibitor of cytochrome P450 3A4 and 2D6.

DISCUSSION

Many naturopathic medicines have been used for decades, if not centuries, although their efficacy has not been proven by modern scientific standards. The lack of conclusive scientific evidence does not necessarily mean that these remedies do not work or are unsafe, but simply that rigorous scientific exploration has not been performed. Most medications, herbal preparations, and nutraceutical supplements have notable effects on biochemical pathways; however, any substance in a large enough concentration will have a biochemical effect. Caution is necessary in testing these agents because frequently, essential details regarding type of extract, concentration, and formulation are not stringent adhered to, thereby impeding safe and accurate application of the scientific method.
Table 3. Herbal medications to avoid within 2 weeks of surgery

<table>
<thead>
<tr>
<th>Bleeding effects</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gingko biloba</td>
<td></td>
</tr>
<tr>
<td>Garlic</td>
<td></td>
</tr>
<tr>
<td>Ginseng</td>
<td></td>
</tr>
<tr>
<td>Fish oils (omega-3 fatty acids)</td>
<td></td>
</tr>
<tr>
<td>Dong Quai</td>
<td></td>
</tr>
<tr>
<td>Feverfew</td>
<td></td>
</tr>
</tbody>
</table>

Cardiovascular effects
- Ephedra (tachycardia, hypertension, and palpitations)
- Garlic (hypotension)

Anesthetic effects
- Valerian root
- St. John’s wort
- Kava

Drug interactions (see Table 2)
- Echinacea (cytochrome P450, corticosteroids, and cyclosporine)
- Goldenseal
- Licorice
- St. John’s wort
- Kava
- Valerian root

Other
- St. John’s wort and Dong Quai (photosensitivity)
- Ginseng (hypoglycemia)

Quality Control/Standardization
In 1990, the US Congress instituted the Nutrition Labeling and Education Act. This act was twofold. First, it required manufacturers of dietary supplements to provide evidence that their product was safe for consumption before sale. Second, manufacturers had to substantiate the accuracy of their health claims to the FDA. Only 4 years later, Congress exempted dietary supplements and alternative medicines from FDA regulation. Following this exemption, the only legal requirement placed on these substances was that they not be represented as preventing or treating a specific disease. This restriction does not limit statements such as “maintaining heart health” or “promoting prostate health.” The burden of proof shifted from the manufacturer to the FDA, requiring that the FDA prove a product unsafe before removing it from circulation.

There is no motivating factor for the manufacturers and distributors of these medications to perform truly scientific (controlled, randomized) studies. Most of the data available are anecdotal. The marketing of certain products may be misleading and potentially harmful. A study focused on Internet marketing of ephedra-containing products revealed that 41% of related websites did not disclose adverse effects or contraindications. Also, more than half of the surveyed sites did not list the dosages needed, while some of the sites made potentially harmful claims. Astoundingly, medications may or may not contain the herb or product listed on the label. Many manufacturers do have stringent quality control and quality assurance procedures in place (although they are not required), but there are those that do not. In an investigation of ginseng-containing products, the amount of ginseng varied from none to 10 times the amount listed on the label. Furthermore, some alternative medicines imported from Asian countries have been found to contain heavy metals (lead, arsenic, and mercury) and undeclared pharmaceuticals.

European regulatory standards for herbal supplementation have undergone several measures of change within the last decade. Despite a decrease in regulatory standards when compared with traditional medications, European standards incorporate several key features not present in FDA standards. Herbal medications must provide data that the herbs are not deleterious as described for usage and that their effects may be plausible. The European regulatory standards also may require labeling that includes any warnings about unsafe usage.

In direct response to many of these issues, the FDA recently established regulations requiring current GMPs for dietary supplements. In effect, this requires manufacturers to evaluate the identity, purity, strength, and composition of their supplements.

In order to ensure quality control and standardization of products, it is prudent to work with preparations manufactured by companies that are adhering to the pharmaceutical standards (GMPs). These products are not often readily available to the general public, but usually dispensed by a licensed medical or naturopathic doctor. Unfortunately, this quality level is not what most patients purchase over the counter.

Patient Disclosure
Open discussion with patients is vital to ensuring their health, safety, and best possible surgical outcomes. There are a number of supplements, herbs, and nutrients that can potentially expedite healing and minimize scarring when used appropriately. Patients need to be aware that full disclosure of all medications—both those that are prescribed and those that are obtained over the counter—can have a significant impact on health and wellness. To that end, a simple questionnaire administered on the initial examination is helpful. It is also prudent to provide patients with surgical guidelines outlining supplements that must be avoided in the perioperative period to minimize potential surgical complications. Table 3 summarizes the various herbal medications that can have a potentially deleterious surgical effect. Providing such information to potential surgical patients opens a channel of communication and reduces the concern that patients may underreport their herbal medication regimen because they perceive their doctors as not caring or understanding.
CONCLUSIONS

A large percentage of the plastic surgery patient population uses one or more herbal medications. Up to 40% use them during the perioperative period. Unfortunately, the disclosure of such medications is limited, because 40% to 70% of patients do not disclose herbal medication usage to allopathic providers. An adequate understanding of these alternative medications and their potential complications will aid the plastic surgeon in decreasing potential adverse outcomes.

DISCLOSURES

The authors have no disclosures with respect to the contents of this article.

REFERENCES


Accepted for publication January 6, 2009.
Reprint requests: David J. Rowe, MD, Department of Plastic Surgery, University Hospitals, Case Medical Center, 29001 Cedar Rd., Ste. 202, Lyndhurst, OH 44124. E-mail: david.rowe@uhhospitals.org.
Copyright © 2009 by The American Society for Aesthetic Plastic Surgery, Inc.
1090-820X/$36.00