Since the passage of the Dietary Supplement and Health Education Act in the mid-1990s, the use of dietary supplements and herbal products has spread throughout America. In fact, an estimated 12% of the US population and 22%-32% of preoperative patients use herbal medications.1-4 In one survey of surgical patients, >1 in 3 had taken an herb within 2 weeks of their operation, and as many as 70% failed to disclose herbal medication use during preoperative assessment.2,5 Specifically, study participants reported taking herbal medications that had effects on coagulation (40.5%), blood pressure (32.7%), cardiovascular system (20%), sedation (16.7%), and electrolytes or diuresis (8.9%).

The extent of herbal product use in the surgical population is difficult to determine, as not all health-care professionals ask about such use when assessing patients. Of surgical patients reporting the use of herbal medications in a 2004 survey, 38% were undergoing orthopedic procedures.6 Patients were asked about herbal medication use by their primary care physician (20%), operating surgeon (17%), anesthesiologist (4%), or other health-care worker (10%). However, only 7% of all patients volunteered information about their use of herbal medications without prompting from health-care professionals. Patients more likely to take herbal medications prior to surgery include females, whites, the educated, and the wealthy. Herbal medication use in the pediatric patient has also been reported.7

Herbal medication use should be discussed during the perioperative patient assessment to prevent potential complications.

The clinical impact of these interactions may range from bleeding to potentiation of anesthesia. Therefore, careful patient screening and product discontinuation prior to procedures is critical.

**COMMON HERBAL MEDICATIONS**

Because a comprehensive review of all herbal medications is beyond the scope of this article, ten common herbal medications and their effects on the perioperative patient are reviewed.

**Echinacea**
- Scientific names: Echinacea purpurea, Echinacea angustifolia, Echinacea pallida.
- Also known as: Coneflower, Purple Coneflower, Black Sampson, Sampson root, Red Sunflower,
Scurvy Root.

- **Common uses:** Treatment or prevention of upper respiratory tract infections. Also used topically for wound infections.
- **Potential complications:** Short-term use may lead to immunostimulation affecting perioperative immunosuppression prior to organ transplantation. Long-term use (>8 weeks) may lead to immunosuppression and risk of postoperative opportunistic infection and poor wound healing. Individuals with atopy may be more likely to have allergic reactions while taking Echinacea. The pharmacokinetics of Echinacea and effects on other medications are unknown.
- **Recommendation:** Discontinue at least 2 weeks prior to surgery.

Ephedrine Alkaloids

- **Scientific names:** Ephedra sinica, Ephedra intermedia, Ephedra equisetina, Ephedra distachya, Ephedra gerardiana, Ephedra shennungiana.
- **Also known as:** Cao Mahuang, Desert Herb, Joint Fir, Ma Huang, Sea Grape, Teamster’s Tea, Yellow Astringent, Yellow Horse.
- **Common uses:** Ephedrine alkaloids (ie, ephedra or ma huang) are used for weight loss, to increase energy, asthma, and bronchitis.
- **Potential complications:** These compounds lead to dose-dependent increases in heart rate and blood pressure. The sympathomimetic effects of these agents have contributed to fatal cardiac and central nervous system complications. In February 2004, the Food and Drug Administration issued a regulation prohibiting the sales of products containing ephedrine alkaloids.10
- **Recommendation:** Discontinue products containing ephedrine alkaloids, regardless of any anticipated operative procedure.

**Garlic**

- **Scientific name:** Allium sativum.
- **Also known as:** Ail, Ajo, Allium, Camphor of the Poor, Nectar of the Gods, Poor Man’s Treacle, Rust Treacle, Stinking Rose.
- **Common use:** To modify the risk of developing atherosclerosis through the lowering of cholesterol and blood pressure.
- **Potential complications:** Garlic leads to irreversible, dose-dependent inhibition of platelet aggregation.
- **This may potentiate the effects of other platelet inhibitors. The antihypertensive effects of garlic are marginal.**
- **Recommendations:** Discontinue at least 7 days prior to surgery to prevent bleeding complications.

**Ginger**

- **Scientific name:** Zingiber officinale.
- **Also known as:** African Ginger, Black Ginger, Cochin Ginger, Gingembre, Jamaica Ginger, Race Ginger.
- **Common uses:** Motion sickness, postoperative nausea and vomiting, anorexia, arthritis, and bronchitis.
- **Potential complications:** Hypoglycemic and positive cardiac inotropic effects. Also inhibits platelets and prostaglandins. Bleeding risk may increase in patients receiving antiplatelet or anticoagulant therapy.
- **Recommendation:** Discontinue at least 7 days prior to surgery.

**Ginkgo**

- **Scientific name:** Ginkgo biloba.
- **Also known as:** Bai Guo Ye, Fossil Tree, Japanese Silver Apricot, Kew Tree, Maidenhair Tree, Salisburia Adiantifolia, Yinhsing.
- **Common uses:** Cognitive disorders, peripheral vascular disease, vertigo, macular degeneration, tinnitus, and erectile dysfunction.
- **Potential complications:** Inhibits platelet-activating factor. There are two reports of subdural hematoma; one report of subarachnoid hemorrhage; and one report of a bleeding iris associated with ginkgo use.11-14
- **Recommendations:** Discontinue at least 7 days prior to surgery due to the increased risk for bleeding complications.

**Ginseng**

- **Scientific name:** Panax quinquefolius.
- **Also known as:** Red Berry, Ren Shen, Sang, Tienchi Ginseng, Wisconsin Ginseng, American Ginseng, Canadian Ginseng.
- **Common uses:** To prevent the effects of aging and increase energy, and for the improvement of stress, blood and bleeding disorders, atherosclerosis, appetite loss, memory loss, headaches, and cancer.
- **Potential complications:** Ginseng contains a pharmacologically active group, the ginsenosides, which lower postprandial blood glucose levels and irreversibly inhibit platelet aggregation.
**Recommendations:** Discontinue at least 7 days prior to surgery to prevent bleeding complications and hypoglycemic episodes.

**Glucosamine and Chondroitin**
- **Scientific names:** 2-amino-2-deoxyglycose sulfate, 2-amino-2-deoxyglycose hydrochloride, chondroitin 4-sulfate.
- **Common uses:** Treatment of osteoarthritis.
- **Potential complications:** Glucosamine may affect insulin sensitivity or production, resulting in elevated blood glucose levels in patients with diabetes. Until definitive evidence of this controversial effect is found, monitoring is recommended. Chondroitin is a minor component (4%) of danaparoid and may have anticoagulant and antiplatelet effects; the clinical significance of these effects is unknown. The potential for pharmacokinetic interactions with glucosamine and other medications is unknown.
- **Recommendation:** Discontinue at least 2 weeks prior to surgery.

**Kava**
- **Scientific name:** Piper methysticum.
- **Also known as:** Ava, Awa, Intoxicating Pepper, Kava Kava, Kava Root, Kava Rauschpfeffer, Sakau, Tonga, Wurzelstock, Yagona.
- **Common uses:** Kava is used as an anxiolytic and sedative.
- **Potential complications:** Sedative effects thought to be mediated through the potentiation of the gamma-aminobutyric acid (GABA) inhibitory neurotransmission. Has the potential to potentiate and prolong the effects of anesthesia.
- **Recommendation:** Discontinue at least 2 weeks prior to surgery. Patients should be tapered off kava over several weeks to prevent withdrawal. If withdrawal occurs, the patient should be treated with benzodiazepines.

**St John’s Wort**
- **Scientific name:** Hypericum perforatum.
- **Also known as:** Amber, Demon Chaser, Fuga Daemonum, Goatweed, Hardhay, Hypereikon, Hyperici Herba, Johns Wort, Klamath Weed, Millepertuis, Rose, Tipton Weed.
- **Common use:** Antidepressant.
- **Potential complications:** The use of St John’s Wort can significantly increase the metabolism of drugs (Table). The metabolic activity of liver enzyme cytochrome P450 3A4 almost doubles. Medications metabolized via P450 3A4 include alfentanil, midazolam, lidocaine, cal-

Of surgical patients reporting the use of herbal medications in a 2004 survey, 38% were undergoing orthopedic procedures.

### TABLE

<table>
<thead>
<tr>
<th>Target Drug</th>
<th>Mechanism of Drug Interaction</th>
<th>Potential Clinical Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anticonvulsants (carbamazepine, phenobarbital, and phenytoin)</td>
<td>Induction of CYP3A4</td>
<td>Reduced target drug blood concentrations with risk of seizures</td>
</tr>
<tr>
<td>Cyclosporin</td>
<td>Induction of CYP3A4 and the transport protein P-glycoprotein</td>
<td>Reduced target drug blood concentrations with risk of transplant rejection</td>
</tr>
<tr>
<td>Digoxin</td>
<td>Induction of the transport protein P-glycoprotein</td>
<td>Reduced target drug blood concentrations with possible loss of control of heart rhythm or heart failure</td>
</tr>
<tr>
<td>HIV protease inhibitors, non-nucleoside reverse transcriptase inhibitors</td>
<td>Induction of CYP3A4</td>
<td>Reduced target drug blood concentrations with possible loss of HIV suppression</td>
</tr>
<tr>
<td>Oral Contraceptives</td>
<td>Induction of CYP1A2 and CYP3A4</td>
<td>Reduced target drug blood concentrations with risk of unintended pregnancy and breakthrough bleeding</td>
</tr>
<tr>
<td>Selective Serotonin Reuptake Inhibitors, Triptans</td>
<td>Potentiation of serotonin concentrations</td>
<td>Increased serotonergic effects with risk of increased incidence of adverse reactions</td>
</tr>
<tr>
<td>Theophylline</td>
<td>Induction of CYP1A2</td>
<td>Reduced target drug blood concentrations with possible loss of control of asthma or chronic obstructive pulmonary disease</td>
</tr>
<tr>
<td>Warfarin</td>
<td>Induction of CYP2C9</td>
<td>Reduced anticoagulant effect and need for increased warfarin dose</td>
</tr>
</tbody>
</table>
Potential complications:

- Medications metabolized via P450 2C9 include warfarin and some nonsteroidal anti-inflammatory drugs.
- Recommendation: Discontinue at least 7 days prior to surgery. This is especially important for patients waiting for organ transplantation or those who may need oral anticoagulation postoperatively.

Valerian

- Scientific name: Valerian officinalis, Valeriana jatamansi, Valeriana edulis, Valeriana sitchensis.
- Also known as: Amantilla, All-Heal, Baldrian, Bel- Gardian Heliotrope, Valeriana officinalis, Valeriana jatamansi, Bal- ria, Baldrian, Bel-ipvium Valerian, Common Valerian, Fragrant Valerian, Garden Heliotrope, Valeriana rhizome.
- Common use: Sedative for insomnia.
- Potential complications: Valerian causes dose-dependent sedation through the modulation of GABA neurotransmission. Abrupt withdrawal of valerian has led to a syndrome that mimics benzodiazepine withdrawal. In animal models valerian increases barbiturate-induced sleep. Potentiation and prolongation of anesthetics is possible.

- Recommendations: Discontinue at least 2 weeks prior to surgery. Patients should be tapered off valerian over several weeks to prevent withdrawal. If withdrawal occurs, the patient should be treated with benzodiazepines.

BOTTOM LINE

Because of the extent of herbal medication use by surgical patients, a discussion of herbal medications and specific documentation regarding their use should be included in the preoperative patient assessment. Patients should be asked to bring all medications and herbal products to this assessment to help the physician properly identify the preparation the patient is using and recommend discontinuation as warranted.

The surgical literature has provided some recommendations for the management of herbal medications perioperatively. Nevertheless, yet a consensus has not been reached. The American Society of Anesthesiologists has no official guidelines on the use of herbs perioperatively, but recommends patients discontinue herbal medications 2 weeks prior to surgery. Until a consensus for the management of herbal medications is reached, the conservative approach is to discontinue all herbal medications at least 2 weeks prior to surgery. An alternative approach is to make decisions regarding management based on the pharmacokinetics and pharmacodynamics of the individual compound. When this approach is used, recommendations for discontinuation may range from 24 hours to 2 weeks. Physicians must know what medications and herbal patients are taking and provide instructions for management perioperatively to prevent potential complications.

REFERENCES
