Complementary and alternative medicine for pediatric otitis media

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Objective: To review the literature involving complementary and alternative medicine (CAM) for pediatric otitis media. Multiple modalities are discussed, including prevention involving breastfeeding, nutrition, and vaccination; symptomatic treatment involving homeopathy, natural health products, and probiotics; manual manipulations involving osteopathy and chiropractics; and traditional Chinese and Japanese medicine. The information presented will assist physicians in advising patients on their decision-making during the early stages of otitis media when antibiotics and surgery are not yet indicated.

Methods: A systematic literature search was conducted through January 2012 in PubMed using MESH term “otitis media” in conjunction with “complementary therapies,” “homeopathy,” “manipulation, osteopathic,” “manipulation, chiropractic,” “acupuncture therapy,” “probiotics,” “naturopathy,” and “xylitol.” Theses searches yielded 163 unique results. Abstracts and titles were evaluated for relevance. Case reports, case series, randomized controlled trials, and basic science research were included. Publications not relevant to the discussion of alternative medicine in otitis media were excluded. Bibliographies were checked for further publications. Thirty-six unique publications were reviewed.

Results: Of all therapies in complementary and alternative medicine, only xylitol has been studied in well-designed, randomized, blinded trials; it is likely effective, but compliance limits its applicability. Conclusions: Management of acute otitis media begins with watchful waiting. Herbal eardrops may help relieve symptoms. Homeopathic treatments may help decrease pain and lead to faster resolution. Prevention should be emphasized with elimination of risk factors, such as second hand smoke and bottle-feeding, as well as maintaining nutrition and vaccinations. Vitamin supplementation may be helpful. Probiotics and xylitol may be beneficial as well. Traditional Chinese/Japanese therapies show promising results but remain speculative until further research is conducted. Severe cases of otitis media with complications or those that fail to improve with observation or CAM (after 48–72 h) should be treated with antibiotics and, in some cases, surgical intervention. It is best to consult a physician when making treatment decisions for full guidance on the risks and benefits of any treatment option.

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1. Introduction

Otitis media is one of the most common diseases of childhood. It has a peak incidence between ages 6 and 15 months. Almost half of all pediatric antibiotic prescriptions are written for otitis media, which also prompts more physician visits than any other childhood illness. More than $100 is spent per episode, and the cost of treatment in the US is approximately $2–3.5 billion per year [1].

The American Academy of Pediatrics (AAP) and the American Academy of Otolaryngology and Head and Neck Surgery (AOHNS) define acute otitis media (AOM) as (1) history of acute onset of signs and symptoms, (2) presence of middle-ear effusion, and (3) signs and symptoms of middle-ear inflammation. In 2004, due to concern over antibiotic resistance and the high spontaneous resolution rate (80% within three days), the American Academy of Family Physicians (AAPF) and AAP recommended initial watchful waiting in children with acute otitis media. During this time, families often seek alternative treatments. Unfortunately these interventions are difficult to evaluate secondary to the rapid resolution and natural history of AOM. In this manuscript we discuss current concepts and present a literature review of complementary and alternative medicine (CAM) for otitis media. This literature review was institutional review board exempt.

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2. Prevention

One of the first tenets of many complementary and alternative modalities is prevention. Increased rates of otitis media with bottle-feeding compared to breastfeeding have been shown. In 2009, Sabirov et al. evaluated children with AOM, noting the prevalence of nontypeable Haemophilus influenzae was higher and the presence of specific immunoglobulin G antibodies was lower in bottle-fed infants compared with breast-fed infants [2]. Additionally, smoking around children, large daycare settings, and pacifier use can also play a causative role in AOM [3] (Table 1; Appendix A).

Recently, nutrition and food allergies have been implicated in the pathogenesis of otitis media. In a recent study evaluating nutritional deficiencies, patients with acute supplicative otitis media and chronic otitis media (COM) as well as recurrent AOM were found to have retinol/vitamin A levels lower than in age-matched controls [4]. Zinc deficiencies also have been implicated in AOM. In a meta-analysis in 2009, Elenraïd et al. reviewed rates of AOM/COM and vitamin supplementation, finding evidence that deficiencies of zinc or vitamin A, or both, may lead to increased rates of otitis media [5]; however, in 2010, Abba et al. reviewed 12 randomized controlled trials in which placebo was compared to zinc (given at least once a week for at least one month) and found conflicting reports regarding the efficacy of supplementation [6]. Deficiencies in EPA (an omega 3 fatty acid), vitamin A, and selenium also have been associated with recurrent AOM [7], with supplementation resulting in fewer antibiotic prescitions.

Vaccines also play an important role in AOM prevention. In 2001, the Centers for Disease Control and Prevention recommended all young children should receive the pneumococcal 7-valent conjugate vaccine (PCV7). This led to a decrease in rates of otitis media caused by pneumococcus and decreased tympanostomy tube placement for recurrent disease [8]. Immunization of all healthy infants could prevent over one million episodes of AOM each year. The newer pneumococcal 13-valent conjugate vaccine (PCV13) vaccine was introduced to address the residual burden of pneumococcal diseases that has persisted since the introduction of PCV7. Prevention of preceding viral illnesses, such as influenza, may also decrease the incidence of AOM [9].

3. Symptomatic relief

With watchful waiting recommendations, symptomatic relief of AOM is paramount. Warm compresses, steam, gargling salt water, and decongestant nasal sprays may benefit some patients. Others find herbal eardrops helpful, but their efficacy is unclear secondary to variable composition (usually a combination of marigold [Calendula flores], garlic [Allium sativum], mullein [Verbascum thapsus], St. John’s wort [Hypericum perforatum], lavender, and vitamin E). Comparable rates of analgesia in patients with AOM can be achieved with naturopathic herbal extracts compared to anesthetic ear drops. In 2001, Sarrell et al. compared Otikon Otic Solution (Healthy-ON, Petach-Tikva, Israel), a naturopathic herbal extract, with anesthetic ear drops containing amoxicacine and phenazone in glycerin and found comparable rates of analgesia for AOM [10]. Similarly, significantly faster resolution of symptoms with administration of homeopathic eardrops compared to “standard therapy” has been shown [11]. One Cochrane systematic review labeled naturopathic ear drops “modestly therapeutic” [12]; however, a subsequent Cochrane review found insufficient evidence to determine their effectiveness [13].

4. Complementary and alternative medicine in general

Evaluating the efficacy of CAM for otitis media is difficult due to lack of randomization, unclear time to effect, and disagreement on the definition of CAM itself. Because CAM medications are not regulated by the FDA and patents are not available, there is little economic incentive for research. Despite this, 46% of children aged 1–7 years with three or more episodes of AOM in six months had used some component of CAM, and many fewer of these children (15–34%) were PCV7 or influenza vaccinated [14]. Most CAM studies have significant methodological flaws and no cost analyses, making definitive conclusions difficult.

5. Homeopathy

Homeopathy is based on the like cures like principle: a substance that produces symptoms in a healthy patient can relieve those symptoms in an ill patient. It includes belladonna, chamomila, and Hepar sulphuricum (Appendix B). They are generally regarded as “safe,” but there are reports of an initial worsening of symptoms in approximately 10–20% with AOM [15]. Three severe adverse events were reported in the practice of one homeopathic provider (perforation of a tympanic membrane, cholesteatoma, and mastoiditis), though it is unclear if these are directly attributable to the homeopathic interventions [16].

In a small, non-blinded, randomized controlled trial by Harrison et al. in 1999, 33 children (aged 18 months to 8 years) with otitis media with effusion, abnormal tympanograms, and hearing loss (greater than 20 db) were randomized to either homeopathic therapy or watchful waiting. More patients in the homeopathic group had normal tympanograms compared to the watchful waiting group (75% vs. 31%, P = 0.015). There was also a trend toward improvement in hearing, lower antibiotic use, and lower referral rates to specialists in the homeopathic group, but this was not significant [17].

Compared to conventional treatment, homeopathy may yield faster symptom improvement with less analgesic and antibiotic use [18,19] and may be 14% less expensive [16]. Larger randomized, controlled studies are required to assess the efficacy and safety of these treatments.

6. Other natural health products

Natural health products such as echinacea, cod liver oil, and xylitol are generally regarded as safe, though efficacy is unclear and some patients experience significant gastrointestinal symptoms. While there are many natural health products available (see Appendix C for a more complete list), one of the most common herbs taken in the United States is echinacea, which is generally taken for or to prevent the common cold. Unfortunately, most echinacea products in the United States are derived from Echinacea angustifolia, an herb that has never been shown to improve symptoms related to upper respiratory infections. Only Echinacea pallida root and Echinacea purpurea leaf have demonstrated efficacy in this regard. Looking at a mixture containing echinacea (as well as propolis and vitamin C), Cohen et al. [20] found the

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Risk for AOM</th>
<th>Relative rate</th>
<th>P value</th>
</tr>
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<tbody>
<tr>
<td>Family history of AOM</td>
<td>AOM</td>
<td>2.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Daycare outside home</td>
<td>AOM</td>
<td>2.5</td>
<td>0.003</td>
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<tr>
<td>Not breastfeeding at all</td>
<td>Recurrent AOM</td>
<td>2.1</td>
<td>&lt;0.001</td>
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<tr>
<td>At least one sibling</td>
<td>Recurrent AOM</td>
<td>1.9</td>
<td>0.001</td>
</tr>
<tr>
<td>Child care outside home</td>
<td>Recurrent AOM</td>
<td>1.8</td>
<td>0.004</td>
</tr>
<tr>
<td>Parental smoking</td>
<td>AOM</td>
<td>1.7</td>
<td>&lt;0.001</td>
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<tr>
<td>Family daycare</td>
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<td>1.6</td>
<td>0.002</td>
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<td>Pacifier use</td>
<td>AOM</td>
<td>1.2</td>
<td>0.008</td>
</tr>
<tr>
<td>Breast feeding &lt;3 months</td>
<td>AOM</td>
<td>1.2</td>
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Adapted from Uhari et al. [3].

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mixture reduced the number of AOM episodes per child by 68% (P < 0.001) compared to placebo among 430 children. Unfortunately, side effects involving gastrointestinal-type symptoms were reported in 9 children, including 7 from the mixture group and 2 from the placebo group (P = 0.54).

Xylitol, a natural sugar found in many fruits and used as a sweetener in chewing gum, is also thought to have preventative properties in otitis media. Uhr et al. in 2000 found xylitol inhibited the growth of *Streptococcus pneumoniae* and inhibited the attachment of both *S. pneumoniae* and *H. influenzae* to nasopharyngeal cells [21]. Kurola et al. in 2009 offered a possible explanation for this: exposure to xylitol lowered cpsB (pneumococcal capsular locus) gene expression, which changes the ultrastructure of the pneumococcal capsule [22]. Perhaps more clinically relevant, Uhr et al. in 1996 found in a randomized controlled trial that xylitol (8.4 g/d in divided doses 5 times daily) reduced the occurrence of AOM by 41% (95% CI: 4.6% to 55.4%) [23]. In addition, fewer of the children receiving xylitol required antibiotics during the study period (18.5% vs. 28.9%, P = 0.032) [23]. In 1998, the same group demonstrated a 40% reduction of otitis media in patients receiving xylitol gum, 30% reduction in those receiving syrup, and 20% reduction in those receiving xylitol lozenge, compared with controls [24]. In 2000, they further corroborated these findings in a study looking at chewing gum vs. syrup vs. controls and found the efficacy: at 2 to 3 months was 40% with chewing gum and 30% with syrup. Interestingly, xylitol was ineffective in children with indwelling tympanostomy tubes [21]. Most studies show some efficacy of xylitol in preventing AOM, but Tapiaen et al. compared xylitol mixture, control mixture, control chewing gum, xylitol chewing gum, and xylitol lozenges given during an active upper respiratory infection and found no preventive effect for xylitol in any form [25]. Most studies report a 5-times-a-day dosing schedule, which likely limits full compliance. To address this, Hautalahti et al. looked at 3 times daily xylitol for 3 months (9.6 g/d divided into 3 doses) and found no preventive effect over control solutions/gum in preventing otitis media [26]. Furthermore, xylitol has common side effects including abdominal pain and diarrhea, which often lead to noncompliance with such frequent dosing.

7. Probiotics

Probiotics are microorganisms thought to confer health benefits by restoring microbial balance. There is conflicting evidence on the effectiveness of probiotics in preventing AOM.

In a randomized controlled study by Hatakka et al. in 2001, 571 children were randomized to receive milk with or without *Lactobacillus rhamnosus* 3 times daily, 5 days a week, for 7 months. There was a significant decrease in the number of days absent from daycare in the probiotic group but only a slight trend toward fewer episodes of AOM [27]. In a later study by Hatakka et al. in 2007, children were randomized to receive a probiotic capsule or placebo daily for 24 weeks. While there was a large dropout rate, they found probiotics did not reduce the occurrence or recurrence of otitis media. They also obtained nasopharyngeal samples at 3 points in time and showed no reduction in the presence of *S. pneumoniae* or *H. influenzae* but an increased prevalence of *M. catarrhalis* [28].

Conversely, Roos et al. in 2001 reported on the use of a probiotic nasal spray in children and found preventive effects on AOM and COM (42% without recurrence in the probiotic group vs. 22% in the placebo group, P = 0.02) [29]. More recently, in 2008, Stecksen-Blicks et al. showed milk supplemented with probiotics and fluoride consumed once daily, 5 days a week, for 21 months, had preventive effects on otitis media (0.4 days of otitis media vs. 1.3 days of otitis media, P < 0.05) [30]. Rautava et al. in 2009 looked at probiotics in infants by supplementing formula for infants younger than 2 months compared to placebo supplementation daily until the age of 12 months. There was a significant reduction in the number of episodes of otitis media in the first 7 months of life (22% vs. 50%; risk ratio [RR], 0.44 [95% CI, 0.21, 0.90]; P = 0.014) and a decrease in the amount of antibiotics prescribed (31% vs. 60%; RR, 0.52 [95% CI, 0.29, 0.92]; P = 0.015) [31]. These conflicting reports highlight the need for further research in this area.

8. Osteopathy

Osteopathy is a therapy based on the concept that the body can heal itself when it is in a normal structural relationship, normal environment, and has good nutrition. Craniosacral therapy, often used for AOM, is manipulation of the bones and tissues of the head and neck to affect “osteopathic restrictions.”

Osteopathic manipulative treatment (OMT) for AOM include myofascial release, articulation, balanced membranous tension, balanced ligamentous tension, facilitated positional release, and counter strain on “areas of restriction.” In combination with antibiotics, these procedures can decrease the frequency of AOM as well as the need for tympanostomy tubes compared to antibiotics without OMT [32]. A randomized controlled trial by Mills et al. in 2001 randomized OMT for treatment of otitis media. Children 6 months to 4 years with recurrent AOM were randomized to standard care (such as antibiotics) either with or without OMT over 6 months. Patients in the OMT group had fewer episodes of AOM per month (P = 0.04) and less need for tympanostomy tubes (P = 0.03). There was no difference in antibiotic use, parental satisfaction, or hearing results. Unfortunately, there was a large dropout rate (25%), making conclusions difficult [32]. Many OMT studies have a lack of controls, small group sizes, and high dropout rates [33].

Other OMT for otitis media includes the “Galbreath maneuver” (movement of the mandible to indirectly generate a pumping action on the Eustachian tube that purportedly drains the middle ear) [34]. The “Munce” and “modified Muncie” techniques involve placement of a fingertip on Rosenmuller’s fossa or the posterior tonsillar pillar, respectively, to open the Eustachian tube [35–37]. Effectiveness of these techniques is mainly anecdotal but warrants future research.

9. Chiropractics

Chiropractics is based on the principle the body can heal itself when the skeleton is in correct alignment. Chiropractors feel manipulations improve innervation and function of the tensor veli palatini, which helps treat or prevent otitis media.

Froehle examined the effectiveness of chiropractics in 46 children with AOM aged 5 years and younger. Patients were given 3 treatments per week for 1 week, then 2 treatments per week for 1 week, and then 1 treatment per week with termination at any point when parents, physicians, or the chiropractic practitioner deemed the child improved. Overall, 93% of AOM improved, 75% of which improved within 10 days and 43% with only 1 or 2 treatments [38]. In 2004, Zhang et al. looked at otitis media resolution in 21 children (aged 9 months to 9 years) diagnosed with AOM (defined by tympanic membranes appearance and fever). These children were treated with “tightness” (low force) chiropractic adjustments over 14 days, and overall, 95% had return of normal-appearing tympanic membranes and a decrease in their fevers. Unfortunately, there was no control group and thus conclusions are difficult [39]. Fallon [40] examined 332 children (aged 27 days to 5 years) with a diagnosis of otitis media (acute or chronic) for effectiveness of chiropractic manipulation. Children who had AOM (n = 127) received an average of 4 ± 1.03 adjustments and attained normal otoscopic exams and...
tymanograms after 6.67 (±1.9) and 8.35 (±2.88) days, respectively. These children also had an overall AOM recurrence rate of only 11% in 6 months. Patients with chronic OM required 5.0 ± 1.53 adjustments, attained normal otoscopic exams in 8.57 ± 1.96 days, and had normal tympanograms in 10.18 ± 3.39 days [40]. There is some concern over the safety of chiropractics in a pediatric population. Children may be at increased risk for injury following rapid rotational movements or forces secondary to anatomic immaturity. Serious adverse events have been reported with chiropractics, such as paraplegia and death [41]. Overall, the effectiveness of chiropractic medicine in treatment of otitis media is unclear because the few existent studies all have significant methodological shortcomings.

10. Traditional chinese and japanese medicine

Traditional Chinese medicine (TCM) practices encompass many healing modalities, including acupuncture, moxibustion (heat therapy), Amma or Tuina (ancient massage techniques), diet, and herbs to create harmony and balance within the body. Traditional Japanese medicine (Kampo) has its roots in TCM. Both acupuncture and Chinese/Japanese herbal medicines are approved by the World Health Organization as therapies to treat COM and AOM. Acupuncture is based on the notion that the body’s energy force, chi, travels channels that can become blocked; small needles are inserted to correct this flow of the energy. A randomized, controlled trial in dogs has shown efficacy of acupuncture compared to sham therapy in preventing otitis media (93% prevention vs. 50%). Thirty-one dogs with recurrent otitis media were randomized to conventional medicine with either sham acupuncture or actual acupuncture in four sessions. Over the subsequent year, 14 (93%) dogs in the acupuncture group were free of otitis, compared with 7 (50%) in the sham group (P < 0.01) [42]. It has been suggested that acupuncture has immunomodulatory effects that may play a role in the clearance of middle ear fluid.

Many combinations of herbs exist in traditional Chinese medicine and include skullcap (Scutellaria baicalensis), alisma (Alisma plantago-aquatica), plantain (Plantago major), bupleurum (Bupleurum Chinese), and licorice (Glycyrrhiza uralensis). Research is limited by sample size, randomization, and outcome measures, and few studies are in English. Animal studies are more numerous: in the guinea pig, sairei-to enhances mucociliary clearance [43] and prevents endotoxin-induced otitis [44]. Eryanling liquid reduces inflammatory exudates and mucosal swelling in guinea pigs and may enhance the immune system of mice [45]. Patients have noted improved hearing but no change in otalgia after taking Qingjiao capsules [46]. Allergina (a combination of many herbs) may decrease the signs of otitis media compared to antibiotics as a result of a change in cytokine profiles [47]. Other studies have shown the efficacy of Tongjiao [48] and borneol-walnut oil [49]. Again, these are all limited by sample size, randomization, and outcome measures.

In Kampo, providers evaluate unique patterns of disharmony in patients through patient history and examination of the tongue and pulses. Kampo’s effectiveness may be due in part to selective increase in ion transport across the ear epithelium [50]. The herb Junsen-taiho-to (TJ-48) was shown to decrease hospital visits, antibiotic treatments, and fevers in 24 otitis prone infants. Upon discontinuation, many had recurrent OM, but rates again decreased after resumption [51].

11. Other therapies

Aromatherapy with lavender essence, chamomile, cajuput, evening primrose oil, flax oil, and borago has been used to treat otitis media but has not been well studied to date. Ayurvedic medicine, developed in ancient India, is based on the principle of balance. In otitis media, the lymph nodes outside the ears are massaged to open the Eustachian tubes. Often a drink made with the herb amla (which contains vitamin C and may have antiviral properties) is given.

12. Summary and recommendations

According to the AAFP and AAP, management of AOM begins with watchful waiting. Herbal eardrops may help relieve symptoms. Homeopathic treatments may help decrease pain and lead to faster resolution. Prevention should be emphasized with elimination of risk factors such as second hand smoke and bottle-feeding, as well as maintaining nutrition and vaccinations. Osteopathy and chiropractics may lead to improvement in symptoms; however, case reports cast doubt on the safety of these methods. Vitamin supplementation may be helpful. Probiotics and xylitol may be beneficial as well. Of all CAM therapies, only xylitol has been studied in well-designed, randomized, blinded trials; it is likely effective but compliance limits its applicability. Traditional Chinese/Japanese therapies show promising results, but they generally have not been evaluated in double-blind, randomized, controlled studies and thus remain speculative.

Severe cases of otitis media with complications or those that fail to improve with observation or CAM (after 48–72 h) should be treated with antibiotics and, in some cases, surgical intervention. It is best to consult a physician when making treatment decisions for full guidance on the risks and benefits of any treatment option.

Conflicts of interest

No conflicts of interest exist to disclose for any of the authors.

Appendix A

In 2004, as part of their guidelines, the American Academy of Pediatrics and the American Academy of Family Physicians recommended initial observation of AOM in selected patients:

- 6 months to 2 years: nonsevere illness at presentation and uncertain diagnosis
- 2+ years: nonsevere illness at presentation or uncertain diagnosis

If symptoms do not resolve in 24–48 h, patients should then be treated with antibiotics.

Appendix B

List of common homeopathic remedies used to treat otitis media and conditions they are used for. Most commonly used remedies:

- Aconitum/Aconite/Aconitum napellus: For throbbing ear pain that comes on suddenly after exposure to cold or wind and in children with high fever and whose ears are bright red or tender to the touch.
  Better in the initial stages of an ear infection.
- Belladonna: For throbbing and sharp pain accompanied by fever, intense heat, and flushing in the outer ear and along the side of the face. Some suggest it is better for the right ear. It comes from an extract from a poisonous plant of the nightshade family and should be used with caution.
- Capsicum: Treats heat, inflammation, and significant pain.
- Chamomilla: For children with otitis media who are very irritable, in great pain, and inconsolable.
**Ferrum phosphoricum**: In early otitis media, this is a common remedy used; gradual onset of symptoms; patient has flushed face, doesn’t like noise, wants to lie still.

**Hepar sulphurificum**: Pain in ears especially with swallowing; yellowish-green discharge, wind or draft aggravates pain.

**Kali muraticum**: Popping and crackling sound heard in ear when swallowing and with nose blowing, hearing may be decreased, feeling of fullness and congestion in the ear. Also used to clear Eustachian tubes when fluid persists after AOM.

**Lycopodium**: For right-sided ear pain that is worse in the late afternoon and early evening; fullness of the ears, ringing or buzzing of the ears.

**Magnesia phosphorica**: Earache, especially after exposure to cold wind and drafts. May not be an infection at all, but rather nerve irritation, more right ear than left; pain relieved by heat, feels better with rubbing.

**Mercurius**: Good for chronic ear infections; for pain that is worse at night and may extend down into the throat; relief comes from nose blowing; earache may occur when damp or fog or weather changes occur, may salivate or sweat.

**Pulsatilla**: For infection following exposure to cold or damp weather; the ear is often red and may have a yellowish/greenish discharge from ear or nose; ear pain may worsen after sleep and with warmth, may be alleviated by cool compresses.

**Silica**: For chronic or late stage infection when the child feels chilly, weak, and tired; sweating may also be present.

**Verbascum**: Especially left-sided otitis media, may have a cough or laryngitis as well.

**Appendix C**

List of common natural health products used to treat otitis media.

**Chamomile** (*Matricaria chamomilla*): It is thought to have antiviral properties and has been used for infant colic, digestive upset, and diarrhea. The oil fraction is believed to have the anti-infective properties, while the flavonoids are thought to be anti-inflammatory. There is little evidence for its use in otitis media. It comes as a tincture (1–3 ml three times daily; infants: 1–3 drops/1 lb body weight three times daily) and a tea (1 cup of boiling water over 1 heaping tbsp of flowers). Occasionally patients are allergic to it.

**Cleavers**: Used to assist lymphatic clearance of debris during AOM or with serious otitis media. Tincture 0.5–2 ml three times daily. Tea is also used: 1 cup two or three times daily.

**Cod Liver Oil**: A source of omega-3 fatty acids and vitamins A and D. It has been shown that patients with recurrent otitis media have low blood levels of some omega-3 fatty acids, vitamin A, and selenium. Safety of long-term consumption of cod liver oil is not known; studies have shown adverse health effects from polychlorinated biphenyls and dioxin residues found in fish oil.

**Echinacea** (*Echinacea purpurea*): Its activity is believed to be nonspecific activation of the immune system (including activating natural killer cells and macrophages and increasing circulating levels of alpha interferon), but there is some evidence that the caffeic esters are antibacterial and antiviral and the polyacetylenes may be bacteriostatic. It is most commonly used for treatment of upper respiratory infections, but it is not well studied for otitis media specifically. Dose of echinacea: tinctures, either in alcohol or glycerites, are available. Children: 1–5 ml three to five times daily, infants: 1 or 2 drops/1 lb body weight three times daily. Tablets, capsules, and whole herb taken as tea or infusion are also used orally.

**Elder flower/berry** (*Sambucus nigra*), **European elder** (*Sambucus canadensis*), or **American elder** (*Caprifoliaceae*): Used to dry excessive nasal secretions, also has antiviral activity, best during AOM, especially if an upper respiratory tract infection is present. Tincture 0.5–3 ml 3 times daily. Tea is also used: 1 cup two or three times daily.

**Elecampane root** (*Inula helenium*): Bacteriostatic and antiviral activity and may strengthen resistance of mucosal lining. Can be used in AOM or chronic serious otitis media. Tincture 0.5–2 ml three times daily.

**Eucalyptus**: Administered usually as steam inhalation and is used mostly late in the course of AOM.

**Goldenseal** (*Hydrastis canadensis*): Used only during AOM when there is evidence of purulence. Tincture 0.5–2 ml three times daily.

**Marshmallow** (*Althea officinalis*): Used for soothing inflamed mucous membranes and helps loosen and moisten thick mucus. In otitis media, it is used particularly to help open the eustachian tube. Tincture: 1 drop per 2 pounds of body weight (up to 2 ml) three to six times daily. Decoction: 1 tbsp root simmered in 1 cup of water for 10 min; 1 to 3 tbsp of the strained liquid is taken two to six times daily. If taking with prescription medications, take the medications at least 1 h before or 2 h after taking marshmallow root, because the herb may decrease the absorption of drugs.

**Mullein** (*Verbascum thapsus*): Decreases phlegm and strengthens the respiratory mucosa and acts topically as a local anti-inflammatory. It can be used as topical ear oil for otitis externa. For otitis media, it is chosen to unblock the eustachian tube and to decrease inflammation. Tincture: 1 drop per 2 pounds of body weight every 4 h. Tea: 1 to 2 tsp herb/cup of boiling water, steeped covered 10–15 min, and strained; 1–4 cups per day.

**Usnea** (*Usnea barbata*): Has antiviral and antibacterial properties, used during acute episodes of otitis media. Tincture 0.5–5 ml three times daily.

**Xylitol**: Used as an artificial sweetener in chewing gum and has been shown to inhibit the growth of *Streptococcus pneumoniae* by changing the ultrastructure of the bacterial capsule. Many studies show effectiveness of xylitol (gum > syrup) in preventing otitis media when given five times daily. It can cause abdominal pain and loose stools, which leads to large dropout rates from many studies and difficulty drawing meaningful conclusions. It also prevents dental caries.

**References**

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