Phytotherapy for Lower Respiratory Disease: Basic Principles

Traditional herbal strategies for treating lung disease are founded on supporting and tonifying the innate protective resources. This is one area where the divide between traditional and modern approaches is particularly great. There are very few modern endorsements of early treatment strategies. Modern medical science, which at first embraced such agents in the earlier part of this century, now sees no role for their use. For example, modern editions of Martindale’s Extra Pharmacopoeia claim that: “There is little evidence to show that expectorants are effective.” Some modern drugs may have expectorant activity, such as bromhexine, but they are usually referred to as ‘mucolytic’. The impact of traditional remedies on the respiratory system is relatively poorly researched. Reliable external measures of change in mucosal functions are elusive; many respiratory diseases are either self-limiting or are among some of the most persistent conditions in the clinic.1

However, while the traditional herbal approach is somewhat lacking in scientific support, it is not without a rational basis. This article will examine some important herbal concepts involved in supporting the innate defenses of the lungs during infection. The key concept of expectorants will be discussed in detail, with a focus on the classification of expectorants and the scientific investigations into their effects.

Expectorants

Part of the problem with expectorants probably arises from confusion over their definition. Another aspect of the dismissal of expectorants stems from the difficulties involved with measuring their efficacy.

The four definitions of expectorants given below highlight the difficulties. The dictionary meaning is only concerned with the actual oral production of phlegm or sputum. Since the majority of mucus produced from the lungs is swallowed, this definition is clearly unsatisfactory. Definitions from the pharmacologists Boyd and Lewis are more useful but probably the best definition comes from Brunton, a 19th century pharmacologist.

Oxford Dictionary “Promoting the ejection of phlegm by coughing or spitting.”

Boyd (1954) “An expectorant may be pharmacologically defined as a substance which increases the output of demulcent respiratory tract fluid.”

Lewis (1960) “Expectorants increase the secretions of the respiratory tract and so reduce the viscosity of the mucus which can then act as a demulcent. By virtue of the presence of increased quantities of fluid mucus, expectorants produce a “productive cough” which is less exhausting and less painful to the patient.”

Brunton (1885) “Remedies which facilitate the removal of secretions from the air passages. The secretion may be rendered more easy of removal by an alteration in its character or by increased activity of the expulsive mechanism.”

Why Expectorants?

Many respiratory conditions are characterized by abnormal mucus (catarrh) which can narrow airways. This abnormal mucus may be thick and tenacious and hence very difficult to clear from the airways. If expectorants can render this catarrh more fluid and/or assist in its expulsion, then a clinical benefit should be achieved.

Expectorants can help to relieve debilitating cough. The presence of an irritation in the airways (such as tenacious abnormal mucus) invokes the cough reflex. (The cough reflex is most sensitive in the trachea and larger airways. The sensitivity progressively decreases in the finer airways and in the very fine airways there is no reflex at all. So in alveolitis, there is little stimulation of the cough reflex, whereas for tracheitis the stimulus is strong). By clearing abnormal mucus or by changing its character and making it more demulcent, expectorants can allay cough and are therefore antitussive.

Classification of Expectorants (after Gunn, 1927)

The classification of expectorants by their mode of action is extremely valuable in understanding their appropriate use. In 1927 Gunn proposed four classes of expectorants.2 A fifth class was suggested by the Russian scientist Gordonoff.3

1. Reflex expectorants

These are emetics which cause an increased secretion of respiratory tract fluid when given orally in subemetic doses. Act by reflex from the upper GIT mediated by the vagus nerve eg saponin herbs, Lobelia, Ipecac

2. Central expectorants

Act on the CNS. Possibly Ipecac

3. Parasympaticomimetics

Stimulate the vagus nerve eg Pilocarpus. Also capsaicin in Capsicum stimulates bronchial C-fibres

4. Stimulants of secretory cells

Act directly on goblet cells, eg essential oils

5. Secretomotories (after Gordonoff 1938)

Stimulate mucociliary transport, eg camphor, thyme

From the herbal perspective the two most important classes are the reflex expectorants and the stimulants of secretory cells. The use of the terms stimulating or relaxing expectorants is no longer valuable, as the following quotation illustrates.

“EXPECTORANTS may be defined as drugs which promote the expulsion of secretion or exudates from the respiratory
passages, or which modify their characters. They were formerly classified into stimulating and depressing groups, the former being supposed to increase blood pressure and diminish secretion, the latter to lower blood pressure, increase secretion and promote expulsion. These terms are now generally discarded.44

Reflex Expectorants

There is no doubt that emetics can induce a powerful expectorant effect, as highlighted in the following quotation: “It is safe to assume that even in remote times physicians sought for drugs that would facilitate or increase the flow of bronchial secretion. Almost inevitably they tried to imitate the phenomenon which is known to accompany bouts of nausea when both salivary and the bronchial secretions are noticeably increased by the spread of stimuli from an overactive vagus to the secretory nerve endings in the respiratory tract....

"...The method still finds practical application in the management of non-diphtheritic croupy cough of young children: a substantial emetic dose of tincture of ipecacuanha is administered on a fasting stomach; within ten minutes the child turns pale...and vomits or retches several times. The emetic action is accompanied by an outpouring of bronchial mucus which is removed by more or less violent coughing...such treatment...is undoubtedly effective in clearing stringy, tenacious mucus from the trachea and larger bronchi, and may give striking relief...."55

However, the critical question is whether emetics in subemetic doses can still provide a clinically relevant expectorant effect. This issue was researched in the 1940s by the Canadian scientist Boyd, who used several experimental models.6,5 He was able to show that both saponin-containing herbs (such as Polygonum senega), which can act as gastric irritants, and ipecac exerted expectorant activity at subemetic doses (as measured by an increase in respiratory tract fluid).6,7 The effect was eliminated if the efferent gastric nerves were cut.

Secretory Cell Stimulants

Essential oils from various herbs (either administered as essential oils or contained in herbal extracts or tinctures) are the most important agents which directly influence goblet cells to secrete more respiratory tract fluid (RTF) and mucus. Again Boyd studied the effects of several essential oils in various experimental models.6,7 The most pronounced increase of respiratory tract fluid was seen after ingestion of oil of anise. Interestingly, ingestion of oil of eucalyptus had a moderate effect which was not eliminated by cutting efferent gastric nerves. This finding supports the premise that essential oils do not act as reflex expectorants.

One fascinating aspect of Boyd’s research is that he was able to demonstrate that inhaled essential oils also acted as expectorants. These results are summarized in Table 1.

Table 1 – Expectorant Effect of Inhaled Essential Oils or Their Components

<table>
<thead>
<tr>
<th>Year of Study</th>
<th>Expectorants Studied</th>
<th>Results (RTF = Respiratory Tract Fluid)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1968*</td>
<td>Thuja oil</td>
<td>RTF markedly increased, as was the soluble mucin content of RTF. Effect was most marked in fall</td>
</tr>
<tr>
<td>1969*</td>
<td>Anise oil</td>
<td>No effect at normal doses</td>
</tr>
<tr>
<td>1969*</td>
<td>Eucalyptus oil</td>
<td>No effect at normal doses</td>
</tr>
<tr>
<td>1970*</td>
<td>Menthol</td>
<td>No change in amount of RTF, but its soluble mucin content was increased</td>
</tr>
<tr>
<td>1970*</td>
<td>Thymol</td>
<td>No effect at normal doses</td>
</tr>
<tr>
<td>1970*</td>
<td>Lemon oil</td>
<td>RTF and its soluble mucin content increased</td>
</tr>
<tr>
<td>1970*</td>
<td>Nutmeg oil</td>
<td>RTF and its soluble mucin content moderately increased. Effect most pronounced in fall</td>
</tr>
<tr>
<td>1970*</td>
<td>Citral, geraniol</td>
<td>RTF and its soluble mucin content moderately increased</td>
</tr>
</tbody>
</table>

Anticatarrhals

Anticatarrhal herbs have the following beneficial properties: they reduce excessive discharge from mucous membranes. This discharge may vary from clear and thin to thick and yellowish depending on the condition. They decrease airways hypersensitivity and can also decrease nasal congestion and mucosal edema. Anticatarrhal herbs for the upper respiratory tract include eyebright (Euphrasia officinalis), ribwort (Plantago lanceolata), Ephedra (Ephedra species), elderflower (Sambucus nigra), peppermint (Mentha x piperita), ground ivy (Glechoma hederacea) 

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Boyd found a biphasic effect in that high concentrations of essential oils suppressed RTF and mucin release, whereas lower doses (on the threshold of detection by the nose) had a pronounced stimulatory effect. A seasonal effect was also observed, with an increased activity in fall. These findings provide a rational basis for the hot lemon drink in respiratory infections, since active amounts of lemon oil would be inhaled while ingesting the hot drink.

Overview of Expectorants

- An expectorant is a substance which enhances those physiological mechanisms by which respiratory tract secretions are cleared from the lungs. In the course of doing this they often render the consistency of respiratory tract secretions more fluid and/or more demulcent. They do not necessarily increase the quantity of coughed-up phlegm, nor are they necessarily antitussive.
- Since reflex expectorants and stimulants of respiratory tract secretory cells act by different mechanisms, and on different parts of the lung tissue, an effective herbal prescription should probably combine these two types of expectorants, depending on the patient’s condition.
- The effect and mechanism of action of reflex expectorants has been demonstrated by scientific experiments. However, since their effect seems to involve vagal stimulation of secretory glands, there may also be vagal stimulation of smooth muscle tissue in the lungs. Hence they should be used with caution in asthma, and combined with bronchiolar spasmolytics, but not anticholinergics.
- Many lower respiratory tract disorders will benefit from the action of expectorants, but particularly those where mucus is tenacious and difficult to cough up. However, it depends on the cause of a cough whether an expectorant action is also antitussive.
- Agents with expectorant activity may have other actions, for example some inhaled terpenes may be spasmolytic for bronchiolar smooth muscle.
- Based on animal experiments, oil of anise (and fennel) appears to be a good expectorant when given orally. The expectorant action of inhaled essential oils should not be underestimated. Particularly effective are the lemon-scented terpenes.
- Although the scientific research supporting the therapeutic action of expectorants is by no means conclusive, there is insufficient objective justification for statements like, “There is little evidence to show that expectorants are effective.”
- Key reflex expectorant herbs are Polygala and Lobelia (but many saponin-containing herbs will also have this property).
- Expectorants which are stimulants of secretory cells probably include anise (Pimpinella anisum), thyme (Thymus vulgaris), fennel (Foeniculum vulgare) and white horehound (Marrubium vulgare).
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hederacea, Nepeta hederacea) and goldenseal (Hydrastis canadensis). Goldenseal (H. canadensis) is particularly indicated where there is copious yellow to green discharge of a chronic nature. Goldenrod (Solidago virgaurea) may also fit into this category. Anticatarrhal herbs for the lower respiratory tract include mullein (Verbascum thapsus), Ephedra (Ephedra species) and ribwort (P. lanceolata).

The mode of action of these herbs is not fully understood, especially the herbs rich in the phytochemicals known as iridoids. These include eyebright, ribwort, ground ivy and mullein. Given that so many anticatarrhal herbs contain iridoids, the properties of these compounds are worthy of further investigation in this context.

Respiratory Demulcents

These herbs are rich in mucilage and have a soothing and antiinflammatory action on the lower respiratory tract. Mucilages are generally not chemically well-defined. They are large highly-branched polymeric structures built from many different sugar and uronic acid units (uronic acids are carboxylic acids derived from sugars). They are very hydrophilic (water-loving) and are capable of trapping water (and other molecules) in their cage-like structures to form a gel. Consequently, when a mucilage is mixed with water it swells to many times its original volume as it absorbs water. The saccharide linkages are in a beta configuration which means that human digestive enzymes cannot break down mucilages. Although the mechanism behind reflex demulcency is not clear, an opposite effect to that of the reflex expectorants has been postulated; ie the effect is a reflex one from the demulcent effect on the upper digestive tract, again involving common embryonic origins and vagal innervation.

The major respiratory demulcent herbs are Althaea officinalis (marshmallow root or leaves) and other members of the Malvaceae (mallows), Ulmus spp (slippery elm), members of the Plantago genus, Cetraria islandica (Iceland moss) and Chondrus crispus (Irish moss). Tussilago (coltsfoot) and Symphytum (comfrey) were very widely popular before concerns about pyrrolizidine alkaloids constrained their use. Pronounced antitussive activity has been demonstrated experimentally with oral doses of 1000 mg/kg body weight of extract of Althaea officinalis (marshmallow), with comparable effects at 50 mg/kg of the isolated mucilage.14

Respiratory demulcents were popular for children’s cough and generally for dry, irritable and ticklish coughing. Reflex demulcents are doubly indicated for asthma if it has been linked to esophageal reflux of gastric acid. Here the demulcency additionally allays the irritating effects of acid in the esophagus on the lungs, which is also possibly mediated by a similar vagal reflex to reflex expectoration. A recent paper reported the investigation into the link between acid reflux into the esophagus and coughing or wheezing fits in asthmatic patients.14 The scientists asked a question which has been debated for some time among respiratory and gastrointestinal physicians: “Does cough cause reflux or does reflux cause cough?” They studied more than 100 chronic adult asthmatics and found that half of all their coughs and wheezes occur at the same time as when acid refluxes from the stomach into the esophagus. But more importantly they concluded that in the majority of cases it was the reflux which caused the coughing and not the other way around. The scientists suggested that the potential of antireflux therapy in the treatment of asthma needs to be studied further.

This link between reflux and asthma has long been suspected. In fact there is evidence that reflux is an important cause of asthma in some asthmatics. Monitoring of esophageal acidity revealed reflux in 7 out of 9 patients with persistent asthma.15 In another study 61% of patients with asthma had reflux.16 From studies on children it was concluded that asthma symptoms were more often elicited by exposure of the esophagus to gastric acid than by aspiration of gastric juice.17 However other studies have implicated the importance of acid aspiration.18,19

The chronic cough which often follows a respiratory infection and seems to persist long after the infection is gone is probably due to acid reflux, which in turn was induced by the weakening of the esophageal sphincter as a result of the violent coughing during the infection. A true viscous cycle! Here the role of reflex demulcents is again particularly valuable.

The old-fashioned cough syrups were based on the principle of reflex demulcency. The syrup was not only soothing to the throat, but also relieved coughing coming from the lungs or from esophageal reflux by its demulcent effects.

Conclusions

The use of expectorants, anticatarrhal and respiratory demulcent herbs comprises a key aspect of phytotherapy for diseases of the lower respiratory tract. When these herbs are combined, as appropriate, with those with other actions such as respiratory spasmolytics and antisepsis, a rational approach to the management of both acute and chronic respiratory disease can be developed.

References

4. Young, R.A. The Practitioner, 1940: 436-437
5. Alstead, S. The Practitioner, 1947: 149-153