Halitosis: A Review

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Abstract
Halitosis or bad breath is an oral health condition characterized by unpleasant odors emanating timely from the oral cavity. The origin of halitosis may be related both to oral and systemic conditions, but a large percentage of cases are generally related to an oral cause. Oral causes include mainly tongue coating and various other causes such as deep carious lesions, periodontal disease, oral infections, peri-implant disease, pericoronitis, mucosal ulcerations and impacted food or debris . The unpleasant smell of breath most often results from the microbial degradation of oral organic substrates including volatile sulfur compounds (VSC). So far, there have been a few studies evaluating the prevalence of oral malodor in the general population. Thus, the aim of the present review was to describe the etiological factors, prevalence data and the therapeutic mechanical and chemical approaches related to halitosis.

Key words: Halitosis, etiology, diagnosis, mouthrinse.

Introduction

Halitosis or bad breath are the general terms used to describe unpleasant breath that emits from a person's mouth regardless of whether the odorous substances in the breath originate from oral or non-oral sources.[1] Halitosis is an oral health condition characterized by consistent odorous breath and causative agents include certain foods, poor oral health care, improper cleaning of dentures, decreased salivary flow rate, tobacco products or a medical condition. Though, in vast of the majority, causes are located in the mouth which can be attributed as deep carious lesions, periodontal disease, oral infections, peri-implant disease, pericoronitis, mucosal ulcerations, impacted food or debris and mainly, tongue coating.[2]

The major site of oral malodor production is the tongue, while periodontal disease and other factors seem to be a minor cause of the overall problem.[3] In addition, current social norms emphasize the importance of personal image and interpersonal relationships. Thus, halitosis may be an important factor in social communication and, therefore, may be the origin of concern not only for a possible health condition but also for frequent psychological alterations leading to social and personal isolation.[4] Typically, oral malodor or bad breath results in transient discomfort to most individuals experiencing this unpleasant condition. It also may be imaginary, as seen and observed in a special patient category ; this is called imaginary breath odor or halitophobia .[5]

Etiology

Although in upto 90% of the people with the condition, the source of oral malodor is located in the oral cavity and only a small percentage of cases may be due to non-oral causes, a serious underlying medical condition may warrant immediate referral to a physician.[6]

Halitosis and the presence of oral microorganisms

Gram-negative bacteria species including *Treponema denticola, Porphyromonas gingivalis, Porphyromonas endodontalis, Prevotella intermedia, Bacteroides loescheii, Enterobacteriaceae, Tannerella forsythensis, Centipeda periodontii, Eikenella corrodens, Fusobacterium nucleatum*[7] are most commonly associated with oral malodor .

There is no obvious association that exists between halitosis and any specific bacterial infection, suggesting that bad breath is the result of complex interactions between several oral bacterial species that are known to produce the agents that give rise to oral malodor especially the volatile sulfide compounds, diamines and short chain fatty acids.[8] Most of these compounds result from the proteolytic degradation of various sulfur-containing substrates in food debris, saliva, blood and epithelial cells by the predominant anaerobic gram-negative bacteria.[9] The bacterial interactions are most likely to occur in the gingival crevices and periodontal pockets, but oral malodor can also arise from the posterior dorsal tongue. As a consequence of its large surface area and papillary surface, which roughens the surface topography, the dorsum of the tongue can retain large amounts of desquamated cells, leucocytes and microorganisms.[10]

Systemic conditions related to oral malodor

There are a few systemic (non-oral) medical conditions that may cause foul breath odor, but these are extremely infrequent in the general population. Such conditions are:

1. Fetor hepaticus: an example of a rare type of bad breath caused by chronic liver failure
2. Lower respiratory tract infections (bronchial and lung infections)
3. Renal infections and renal failure
4. Carcinoma
5. Trimethylaminuria ("fish odour syndrome")
6. Diabetes mellitus
7. Metabolic dysfunction

Individuals afflicted by the above conditions often show additional, more diagnostically conclusive symptoms than bad breath.

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Therapeutic approach to manage oral halitosis

Successful treatment of halitosis depends on a correct diagnosis and should preferably be cause related.[11] The treatment plan which comprises elimination of the causative agent and improvement of the oral health status is implemented, after a positive diagnosis for oral halitosis has been made.[12] As has been stated above there are multiple possible etiologies including oral and non-oral causes, the majority of breath malodor cases originate from the oral cavity. The diagnostic approach of halitosis starts by taking a detailed history of the condition, duration, severity, and impact on the patient's social life. Examination involves clinical, radiographic and special tests. Once identified, the contributing medical conditions are referred for treatment accordingly. Clinical examination checks the patient's oral hygiene status, dental caries, and periodontal status; plaque retention factors are also recorded.[12]

Management

Chronic halitosis is not well understood by most physicians and dentists, so effective treatment is not always easy to find. Five strategies may be suggested:

1. Gently cleaning the tongue surface twice daily is the most effective way to keep bad breath in control; that can be achieved using a tooth brush, tongue cleaner or tongue brush/scraper to wipe off the bacterial biofilm, debris, and mucus. An inverted teaspoon may also do the job. Scraping or otherwise damaging the tongue should be avoided and scraping of the V-shaped row of taste buds found at the extreme back of the tongue should also be avoided. Brushing a small amount of antibacterial mouth rinse or tongue gel onto the tongue surface will further inhibit bacterial action.

2. Eating a healthy breakfast with rough foods helps clean the very back of the tongue.

3. Chewing gum: Since dry-mouth can increase bacterial build up and cause or worsen bad breath, chewing sugarless gum can help with the production of saliva, and thereby help to reduce bad breath. Chewing may help particularly when the mouth is dry, or when one cannot perform oral hygiene procedures after meals (especially those meals rich in protein). This aids in provision of saliva, which washes away oral bacteria, has antibacterial properties and promotes mechanical activity which helps cleanse the mouth. Some chewing gums contain special anti-odor ingredients. Chewing on fennel seeds, cinnamon sticks, mastic gum, or fresh parsley are common folk remedies.

4. Gargling right before bedtime with an effective mouthwash. Several types of commercial mouthwashes have been shown to reduce malodor for hours in peer-reviewed scientific studies. Mouthwashes may contain active ingredients that are inactivated by the soap present in most toothpastes. Thus it is recommended to refrain from using mouthwash directly after toothbrushing with paste.

5. Maintaining proper oral hygiene, including daily tongue cleaning, brushing, flossing, and periodic visits to dentists and hygienists. Flossing is particularly important in removing rotting food debris and bacterial plaque from between the teeth, especially at the gumline. Dentures should be properly cleaned and soaked overnight in antibacterial solution (unless otherwise advised by your dentist).

Mouthwashes

There has not been a single documented medical case of successfully cured chronic halitosis using any of the currently available mouthwashes. However a 2008 systematic review determined the efficacy of antibacterial mouthrinses for treating bad breath. Mouthwashes often contain antibacterial agents including cetylpyridinium chloride (CPC), chlorhexidine (which can cause temporary staining of the teeth), zinc gluconate, essential oils(EOs), and chlorine dioxide. Zinc and chlorhexidine provide strong synergistic effect. They may also contain alcohol, which is a drying agent. Other solutions rely on odor eliminators, such as oxidizers, to eliminate existing bad breath on a short-term basis.

A new approach for home treatment of bad breath is the use of oil-containing mouthwashes and two-phase (oil-water) mouthwashes. Essential oils have been found effective in reducing halitosis and are being used in several commercial mouthwashes.

Traditional remedies

According to traditional Ayurvedic medicine, chewing areca nut and betel leaf is an excellent remedy against bad breath. In South Asia, it was a custom to chew areca or betel nut and betel leaf among lovers because of the breath-freshening and stimulant drug properties of the mixture. Both the nut and the leaf are mild stimulants and can be addictive with repeated use. The betel nut will also cause tooth decay and dye one's teeth bright red when chewed. Both areca nut and the betel leaf chewing however are recognised risk factors for squamous cell carcinoma (i.e., oral cancer). Their use is however not recommended.

Research

In 1996, the International Society for Breath Odor Research (ISBOR) was formed to promote multidisciplinary research on all aspects of breath odors. The eighth international conference on breath odor took place in 2009 in Dortmund, Germany.

Approach in reduction of oral microorganisms in the oral cavity

Mechanical approach

Several studies have stated the dorsum of the tongue as the primary source of VSC, both in periodontally diseased and healthy individuals.[13] The papillary structure of the dorsum represents a unique ecological niche in the oral cavity, offering a large area and roughened surface that favors the accumulation of oral debris and microorganisms.[14] Disrupting the tongue biofilm has been emphasized as an aid for mechanical reduction of malodor and of the intraoral bacterial count.[15] Various available instruments can be applied to the tongue, and by gentle pressure the majority of the tongue coating can be scraped off. Brushing the dorsum of the tongue with toothpaste has been shown to be more effective than brushing the teeth.[16] In patients with high levels of oral malodor, a regular toothbrush was signific-

antly less effective in tongue cleaning than a device that brushed and scraped, because of the limited duration of the effect. Therefore, tongue cleaning seems to reduce the substrates for putrefaction, rather than the bacterial load.[17]
In addition, mechanical cleaning of teeth, such as brushing the teeth and flossing reduced the oral bacterial load and bacterial nutrients, thereby presumably reducing oral malodor. Interdental cleaning and tooth brushing are essential mechanical means of oral hygiene. This home care removes residual food particles and organisms that cause putrefaction. However, studies have shown that inter-dental flossing has no added value with regard to reducing morning bad breath.[18] Several studies conducted in subjects free of caries, periodontal disease and tongue coating showed that brushing the teeth exclusively had no appreciable influence on the concentration of volatile sulfur containing compounds in morning breath, when compared with no brushing and rinsing the mouth with water.[19] Since periodontitis can be a factor in chronic oral malodor, professional periodontal treatment is mandatory. Thus, initial periodontal therapy in moderate periodontitis patients can be expected to improve breath odor parameters by reducing the number of periodontopathogens.[19]

Chemical approach
The goal of any antimicrobial treatment would be to reduce the proteolytic, anaerobic flora found on the tongue surface. Mouthrinses with antimicrobial properties can reduce oral malodor by reducing the number of microorganisms chemically. Often used active ingredients in these products are usually the antimicrobial agents such as chlorhexidine, CPC, essential oils and triclosan. Mouthrinses can also reduce halitosis by chemically neutralizing odor compounds.[20] The active ingredients in these rinses are the metal ions and oxidizing agents.

Chlorhexidine (CHX)
CHX gluconate has a very broad antimicrobial spectrum. The American Dental Association has approved its use. It is the most studied antimicrobial agent in the treatment of gingivitis, and also has been found effective in the treatment of halitosis. Due to its substantivity, the anti-VSC effect of the 0.2% solution is satisfactory after 1 h but, more importantly, it shows a tendency to improve at 2 h and 3 h.[21]
A commercial product containing 0.12% CHX-gluconate has been demonstrated as an effective anti-VSC product, and showed kinetics similar to that of the 0.2% CHX solution.[22] Although being considered the gold standard mouthrinse for halitosis treatment, CHX has undesirable side effects. The safety of an effective agent that might be used repeatedly needs to be established. An agent is needed that approaches the clinical efficacy of CHX but with better safety and comfort features.

Essential oils
Essential oils, including hydro-alcohol solutions of thymol, menthol, eucalyptol, and methyl salicylate, have been used in mouthwashes to prevent periodontal disease. An EO mouthrinse was able to reduce the offensive gases present in morning bad breath as measured by a sulfide monitor.[22] Rinsing with an EOs mouthrinse is effective in controlling oral malodor as it can have long-lasting effects in reducing anaerobic bacteria overall as well as Gram-negative anaerobes and VSC producing bacteria.

Triclosan
The triclosan and CPC mouthrinses were more effective in reducing bad breath than in reducing supragingival plaque accumulation. Therefore, it could be postulated that the superior reducing effect of these specific mouthrinses on bad breath may be related primarily to their efficacy in reducing the load of VSC-related microorganisms and oral debris in the whole mouth niches rather than only in supragingival plaque reduction.[23]

Zinc
Metals such as zinc, sodium, tin and magnesium are thought to interact with sulfur. They bind to the metal ions and oxidize the thiol groups in the precursors of volatile sulfur-containing compounds.[24] Morning breath odor can be successfully reduced by the sole use of an amine fluoride- stannous fluoride-containing mouthrinse twice daily, which significantly reduces the bacterial load in the saliva.[25] Unfortunately, both cupric and stannous ions have the potential to discolor teeth, which can be attributed to as a result of sulfide formation on the teeth after extended periods of use or due to the precipitation of dietary chromogen. Zinc is the metal ion of choice with this purpose because of its low toxicity and its other favorable properties, such as not causing dental staining.

Effective combination of agents
Chlorhexidine and zinc
A CHX and zinc mouthrinse had a strong effect on volatile sulfur-containing compounds and was effective for at least 9 hours. Control rinses with CHX or zinc alone had a moderate and strong effect for 1 hour, but this effect diminished with time, respectively, fast and slightly.[21]

Cetylpyridinium and zinc ions
A CPC and zinc mouthrinse had a good synergistic effect on volatile sulfur-containing compounds levels after 1 hour, but minimally above the effect of zinc alone[21]

Chlorhexidine, cetylpyridinium chloride and zinc-lactate
Chlorhexidine is still the gold standard mouthrinse, but it does have some side effects. Due to these disadvantages, new formulations have been developed. Since CHX and CPC are both antimicrobial agents, it seems reasonable to assume that the new marketed mouthwash that contains both these antimicrobial agents acts by reducing the number of VSC-producing bacteria on the dorsum of the tongue. Moreover, zinc-lactate, besides its antimicrobial activity, may reduce VSC scores by transforming them into insoluble compounds.

Conclusion
The present review described the etiological factors related to halitosis and the mechanical and chemical therapeutic approaches. Tongue biofilm seems to be directly involved in the production of oral halitosis and may have an important role in the success of periodontitis therapy since it is a potential reservoir for periodontal pathogens. It is

clear that a successful treatment of halitosis involves an appropriate diagnosis, professional therapy, mechanical plaque control, including tooth brushing and tongue cleaning, possibly combined with the use of an effective antimicrobial mouthrinse.

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