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REVIEW ARTICLE

Halitosis - aetiology, diagnosis, treatment

Karnoutsos K, Blioumi E

Dental Department of General Hospital 'Agios Pavlos'

Diagnosis and treatment of bad breath is a matter that concerns a large portion of the general population and dentists. Malodorous volatile materials produced by some bacteria on the dorsal surface of the tongue are the main cause of bad breath. These are mainly volatile sulfur components, especially methyl mercaptan and hydrogen sulfide, but also short-chain fatty acids and polyamines. It appears that the gram negative anaerobic microflora is responsible for odor formation .through a two-phase metabolic process (hydrolysis and degradation of amino acids). Metabolic processes which result in pH decrease, O_2 decrease or oxidation reduction potential (Eh) increase favor the growth of gram negative anaerobes and the generation of malodor too. The three main methods of analyzing oral malodor are organoleptic measurement, gas chromatography and sulphide monitoring. A thorough medical and dental history helps the dentist to find the origin of halitosis and classify halitosis into three different categories, that is genuine halitosis (physiologic and pathologic), pseudo-halitosis and halitophobia. Furthermore, a thorough extraoral and intraoral examination may eliminate from consideration some other extraoral and intraoral causes of bad breath . The treatment of malodor consists of mechanical and chemical reduction of microbial flora. The most common ways of treatment are cleaning the tongue with a dentalcleaner or a dentalscraper, use of mouthwashes containing zinc, chlorexidine and hydrogen peroxide and periodontal treatment. Patients with pseudo-halitosis and hatitophobia need to be counseled and assisted by a psychological specialist. In conclusion, since malodor is a common condition in general population, all dentists ought to be informed the causes, diagnosis and treatment of halitosis. *Hippokratia 2005, 9 (1): 3-6*

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Corresponding author: Karnoutsos K, "Saint Paul" General Hospital, Thessaloniki, Greece

Oral malodor may rank only behind dental caries and periodontal disease as the cause of a patient's visit to the dentist[1]. The prevalence of malodor is not well documented, but judging by the money spent on deodorant-type mouthrinses, it is considerable[1]. A survey conducted at ADA in USA in 1995 reported that 41% of the dentists saw 6 or more patients a week with 'chronic bad breath'[1]. Approximately 30% of individuals older than 60 years of age reported either thinking that they had bad breath or having been told that they had bad breath[1]. Despite the high priority of this problem to the public, it has traditionally been neglected by the dental profession[1]. This situation is changing since there is increasing interest on the aetiology and treatment of halitosis[1].

Aetiology

Oral malodor is caused by the presence in exhaled air of odoriferous volatile compounds. These are mainly volatile sulfur compounds (VSCs), especially methyl mercaptan (CH_3SH) and hydrogen sulphide (H_2S), but also short-chain fatty acids, such as butyric, propionic, and valeric acids, and polyamines, such as putresceine and cadaverine[1,2,3]. These compounds result from the proteolytic degradation by oral bacteria of sulfur-containing peptides and amino acids in saliva, gingival crevicular fluid, blood, and desquamated epithelial cells[1,3]. From experiments it became evident that the metabolic process consists of two phases[4]. One is the hydrolysis of peptides and proteins to produce amino acids. The second is the degradation of these amino acids to produce end products, some of which are volatile and odoriferous[4]. These products include volatile sulfur compounds (VSCs) from cysteine, cystine, and methionine; indole and skatole from tryptophan; amines from lysine and ornithine; and short-chain fatty acids, possibly from valine, leucine, and isoleucine[4].

It appears from in vitro research that the gram-negative anaerobic microflora is responsible for odor formation[1,2]. Fusobacterium nucleatum, Treponema denticola, Prevotella intermedia, Porphyromonas gingivalis, Bacteroides forsythus, Eubacterium and other subgingival species can produce large amounts of CH_3SH and H_2S from methione, cysteine, or serum proteins[1,2]. Some of these potentially malodorous bacterial species have been isolated from the dorsal surface of the tongue, suggesting that the microbiota of the tongue resembles the malodorous microbiota found in subgingival plaque[1] (Figure 1).

The mucosal surface underneath the tongue coating is often ulcerated, so that the odor-producing tongue bacteria have ready access to serum products in vivo[1]. Other protein sources are diet, host secretions (such as

Figure 1. *Dorsal surface of the tongue*

saliva and crevicular fluid), desquamating epithelial cells and blood remnants[2]. Also identified was the fact that other metabolic processes regularly carried out by the oral microbiota have significant indirect effects on the production of malodor[4]. For example, bacterial fermentation of sugars, which results in an acidic pH, inhibits malodor, whereas neutrality and alkalinity generated by other metabolic processes favor it[4]. Cysteine and cystine, when catabolised by the oral bacteria, generate a decrease in the oxidation-reduction potential (Eh)[4]. This is a physicochemical factor that is important for the growth of gram-negative anaerobes and for the malodor process to proceed[4]. Additionally, proline and glutamate are the main amino acids available from saliva that are involved in oxygen depletion[4]. This process is important for producing anaerobiosis, which in turn helps with the decrease in the Eh that is conductive to the formation of malodor[4].

Patient History

A thorough patient history is the first step a dentist should make in order to diagnose and treat halitosis.

Chief complaint

It is important to determine initially whether the complaint of bad breath is a primary reason for seeking help or, it is one of several complaints that a patient brings to the clinician, for example disturbed taste[5]. Some patients assume that bad taste coexist with bad breath[5]. However, taste disorders may be due to other causes[5]. In many cases, taste dysfunction may be caused not by problems with taste but by alterations in the perception of smell[5].

Medical history

Particular emphasis should be placed on a thorough history of nose, nasopharynx and sinus diseases[5]. In approximately 8% of patients of bad breath, the odor was found to be caused by tonsillitis, sinusitis or a foreign body in the nose[5]. There are reports of tumors in the respiratory tract that produce malodor that emanates from the oral cavity[5]. Facial injuries, cosmetic surgery, radiation and chemotherapy may affect the olfactory epithelium located on the dorsal aspect of the nose, the nasal septum and superior turbinate, altering taste and smell[5]. A history of gastrointestinal diseases, such as gastritis or duodenal and gastric ulcers, has also been found in some patients with oral malodor[5].

Each medication a patient takes must be evaluated for potential contribution to bad breath[5]. Medications can result in the production of body odor and also distort perception of taste and smell[5]. These include antimicrobial agents, antirheumatic , antihypertensive and psychopharmacologic drugs[5].

Many drugs produce xerostomia, which favors malodor[5]. The drugs that produce xerostomia include analgesics, anticholinergics, antidepressants, antihypertensives, psychotherapeutics and numerous others[5]. Other causes of xerostomia, such as Sjogren's syndrome and radiation therapy, also have to be evaluated[5].

Antibiotics suppress the oral flora that produces bad breath, so that patients who are undergoing antibiotic therapy cannot be evaluated for oral malodor until two weeks after their antibiotic regimen is completed[5].

Dental history

A detailed history of oral hygiene habits is required to assess the patient's education, ability, and commitment to the maintenance of oral hygiene[5]. The patient's frequency of brushing and flossing, use of mouthwash, type of toothbrushes and toothpaste, is useful information for improving oral care[5].

Diet and habit history

Habits such as alcohol and tobacco use can contribute to bad breath, as can odoriferous foods, such as garlic, onion and some ethnic foods[5].

Oral malodor history

Direct interview is the most informative means of assessing the history of halitosis[5]. It is important to determine whether the patient noticed that he had bad breath by himself or someone else told him[5]. Another major problem arises when the patient imagines he or she has bad breath, and the examiner cannot detect malodor[5,6]. The history of how long the bad breath has been present, whether certain activities reduce the oral malodor helps to further define the problem[5]. The effect of bad breath on the patient's life also has to be determined[5]. Other history items that may help are further evaluation of the extent of the patient's concern, whether the patient has sought professional help, and whether the suggestions and treatment have helped. It has also to be determined what steps is taking every day to minimize the oral malodor[5,7].

Diagnosis

The next step for the diagnosis of halitosis is the thorough intraoral and extraoral examination.

Extraoral examination

A thorough extraoral examination may eliminate

from consideration some extraoral causes of breath, such as infections or tumors in the pharynx and salivary gland swelling[5].

Intraoral examination

Intraoral examination consists of an assessment of all abnormal findings of oral soft tissues as well as teeth[5]. Caries, endodontic lesions, plaque on teeth and in periodontal pockets or tongue coating can be related to bad breath[5].

The patient should refrain from drinking, eating, chewing, rinsing, gargling and smoking for at least 2 hours before appointments[5,8]. Patients should also avoid using scented cosmetic products before examination[5]. The patient should also abstain from eating garlic, onion and spicy foods for the last 48h[8].

The methods of analyzing oral malodour are:
- Organoleptic measurement
- Gas chromatography
- Sulphide monitoring

Organoleptic measurement is a sensory test scored on the basis of the examiner's perception of a subject's malodour on a 5-point scale[5]. The oral malodor examiner, who should have a normal sense smell, is required to refrain from drinking coffee, tea or juice and to refrain from smoking and using scented cosmetics before the assessment[8]. Both mouth air and nasal air are evaluated with that method[5]. Tongue odor is measured by scraping the dorsal surface with a plastic spoon and smelling its odor[5]. The supragingival plaque odor is estimated by passing floss through interproximal contacts of molars in all 4 quadrants of teeth[5].

Gas chromatography is performed with apparatus equipped with a flame photometric detector, which is specific for detecting sulfur in mouth air[8]. Although gas chromatography is specific for detecting sulphur in mouth air, it is quite impractical because it is not portable and so difficult to use[2,8].

On the other hand, sulphide monitors are portable and easy to use, but most of them are not specific for volatile sulphur compounds[8]. For example, the Halimeter (Figure 2) has high sensitivity for hydrogen sulphide, but low sensitivity for methyl mercaptan, which is a significant contributor to halitosis caused by periodontal disease[8].

Classification

After the examination, the patients should be classified into three categories: genuine halitosis, pseydo-halitosis and halitophobia[8]. Genuine halitosis is subclassified as physiologic halitosis or pathologic halitosis[8]. If oral malodour does not exist but the patient believes that he or she has oral malodour, the diagnosis would be pseudo-halitosis[8]. If, after treatment for either genuine halitosis or pseudo-halitosis, the patient still believes that he or she has halitosis, the diagnosis would be halitophobia[8]. This classification allows the clinician to diagnose a psychological condition[8].

Figure 2. *Halimeter*

Treatment

Treatment needs for halitosis depend on the category to which each patient belongs[8]. Treatment of physiologic halitosis, oral pathologic halitosis and pseudo-halitosis would be the responsibility of dental practitioners[8]. Treatment of extraoral pathologic halitosis would be managed by a physician or medical specialist[8]. Treatment of halitophobia would be managed by a physician, psychiatrist or psychological specialist[8].

There is wide agreement that bad breath originating from the mouth is due to overgrowth of the oral microorganisms, particularly anaerobic bacteria that produce volatile sulfur compounds. Therefore, the treatment is focused on mechanical and chemical reduction of the total load of oral microorganisms in the oral cavity[5,8].

The origin of *physiological halitosis* is mainly the dorsoposterior region of the tongue and the malodour is derived from the tongue coating[8]. Therefore, cleaning the tongue is more important than rinsing the mouth[8]. The tongue coating comprises desquamated epithelial cells, blood cells and bacteria[8]. More than 100 bacteria may be attached to a single epithelial cell on the tongue dorsum, whereas only about 25 bacteria are attached to each cell in other areas of the oral cavity[8]. Hence, cleaning the tongue is a very effective measure for improving physiologic halitosis[8]. However , we do not recommend that patients use a tongue scraper (Figure 3) or adult toothbrush for cleaning the tongue because of possible damage to the tongue surface[8]. An infant toothbrush or

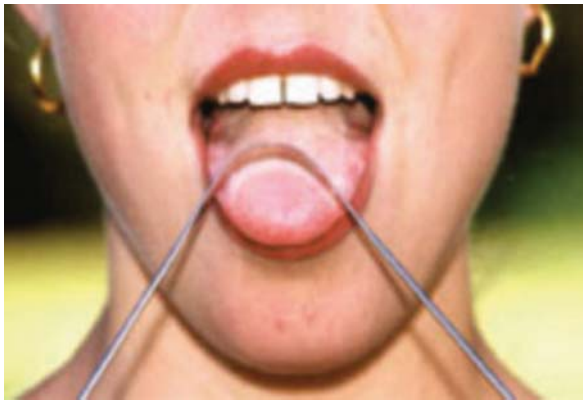

Figure 3. *Dental scraper*

a small tongue brush is recommended[8]. It has been reported that continuous mechanical stimulation enhances carcinogenesis of the tongue in experimental animals[8].

Patients with psychological conditions may overzealously scrape or brush the tongue till bleeding starts; therefore, the patients should receive detailed, comprehensive instruction about tongue cleaning[8]. Furthermore, patients sometimes inappropriately brush or scrape the tongue tonsil because they have been instructed to clean the posterior tongue as far back as possible. It is important to demonstrate to patients the position of the terminal sulcus of the tongue and the anatomical limits for cleaning[8].

Chemical reduction of microorganisms may be accomplished by mouthwashes[1,5,8,9]. One of the most effective agents for plaque reduction has been chlorexidine gluconate, used as a rinse[5,8,9]. The major problem with this agent is that it results in staining of teeth[5,8]. Limiting of drinking of tea and coffee immediately after the use of chlorhexidine may control chlorhexidine-associated tooth staining[5].

Other agents that have been effective in reducing plaque have been essential oils as well as triclosan-containing mouthrinses. Moreover, zinc and hydrogen peroxide indicate efficacy in reducing malodour[5,8,10,11].

Oral pathologic halitosis is managed by periodontal treatment, correction of faulty restorations and treatment of carious lesions[5,8]. Moreover, flossing the interdental surfaces and brushing the teeth helps in the reduction of oral microflora[5] (Figure 4).

Patients exhibiting oral malodour but showing no oral cause of halitosis are classified as having *extraoral pathologic halitosis* and they should be referred to medical specialists[8].

Figure 4. *Flossing*

Patients with pseudo-halitosis mistakenly believe that other individuals' avoidance behaviors are caused by their own oral malodour[8,12]. These patients need to be counseled that the intensity of their malodour is not beyond a socially acceptable level[8]. This step in patient management is most important in differentiating pseudo-halitosis from halitophobia[8]. Pseudo-halitosis patients generally respond favourably to counseling, in constrast with halitophobic patients who cannot accept their perception of malodour and need assistance from a psychological specialist[8].

Halitophobic patients usually refuse to visit a psychological specialist, because they cannot recognize their condition as psychosomatic[8]. The clinician should not deny that the patient has oral malodor and give him oral hygiene instructions[8,13].

In general, oral malodor is a matter that relates to a large portion of general population. Therefore, dental clinicians should be informed about the aetiology, the diagnosis and the treatment of bad breath.

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