

Halitosis: A Review of Current Literature

Halitozis: Güncel Bir Literatür Derlemesi

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Abstract

Halitosis is a term defining disagreeable or offensive odour spread from the breath. Halitosis may occur due to physiological reasons as well as pathological and psychological factor. Because of that, underlying factors of halitosis should correctly be diagnosed and the patient should be directed to the related physician. It is significant to highlight the necessity of an interdisciplinary method for the treatment of halitosis to prevent misdiagnosis or unnecessary treatment. The aim of this review is to report information about the etiology, prevalence, measurement methods and treatment of halitosis.

Keywords

Halitosis, bad breath, measurement methods

Anahtar Kelimeler

Halitozis, kötü kokulu nefes, ölçüm metodları

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Öz

Halitozis terimi nefesten yayılan saldırgan veya nahoş kokuyu tarif eder. Halitozis fizyolojik nedenlerle ortaya çıkabileceği gibi patolojik ve psikolojik nedenlerle de oluşabilir. Bu nedenle halitozisin temelinde yatan faktörler doğru bir şekilde belirlenmeli ve hasta ilgili uzmana yönlendirilmelidir. Yanlış tanı ve tedaviyi önlemek için interdisipliner yaklaşımların halitozis için önemini vurgulamak gerekmektedir. Bu derlemenin amacı halitozisin etiyolojisi, prevalansı, ölçüm metodları ve tedavisi hakkında bilgi vermektir.

Introduction

Many patients consult a specialist physician regarding halitosis complaints (1,2). Halitosis which originates from latin halitus (breath) and greek suffix osis (pathological process) means bad breath in English (3). The history of sources related to halitosis is based on ancient Greek and Roman periods (4) ladanee (Mediterranean countries), parsley (Italy), carnivorous (Iraq), guava shell (Thailand) and egg shell (China) have been used in ancient times for halitosis treatment. Thus, halitosis emerges as a problem that occurs every century and occurs universally in both gender (5). Nachnani (6) indicates that more than 50% of the general population suffer from halitosis. If there are many sources causing halitosis, it is also due to 90% oral cavity such as tongue coat, poor oral hygiene, food impaction, periodontal disease,

pericoronitis, oral ulcers, irregularly arranged teeth, defective restorations, exposed necrotic pulp, acrylic moving prosthesis at night, unclean dentures, and tonsillitis (7,8).

The reasons of absence of scientific data are dissimilarity appreciation of odors for patients and investigators like cultural and racial differences (2). In addition, there is no universal objective method for the diagnosis of a halitosis patient (9).

Prevalence of Halitosis

As a large part of the population is affected by this situation, it has become a source of concern for many people over the last few decades (10). In the general population, halitosis has a prevalence ranging from 50% in the USA, 6% to 23% in China, Indian ranging from 21.7% in males to 35.3% in females (11,12). Miyazaki et al. (13) has shown in his research that the incidence of halitosis increases with age. Halitosis could be seen at all ages, but has different prevalence rates in children and the general population (14-17). Approximately two-thirds of the population is halitosis affected during part of the day, 5% of the population suffers from severe halitosis, which requires immediate intervention (18).

Etiology of Halitosis

Despite the fact that the etiology of halitosis is based on many different cause, it's main reason is the disintegration of organic compounds caused by proteolytic anaerobic bacteria in oral cavity (19,20). Volatile sulfur compounds (VSCs) are products of this putrefaction and also significantly related to the severity of the odor (5,6). VSCs which cause halitosis are formed pathologic and physiologic reasons that originates from oral or extraoral source (21). Sulphur compounds, aromatic compounds, nitrogen-containing compounds, amines, short-chain fatty acids, alcohols or phenyl compounds, aliphatic compounds, and ketones are volatile compounds (22). Hydrogen sulfide, methyl mercaptan and dimethyl sulfide are the most significant examples of VSCs (2). Based on its origin halitosis can be divided into two separate group as genuine halitosis and delusional halitosis (9).

Genuine halitosis:

- Physiological halitosis,
- Pathological halitosis.

Intra oral causes: Periodontal infections, odontogenic infections, xerostomia, mucosal lesions.

Extra oral causes: Acute febrile illness, upper respiratory tract infection, pharyngitis/sinusitis, bronchiectasis, cystic fibrosis, diabetes mellitus, leukemia, pyloric stenosis, hepatic failure, renal failure, peptic ulcer [*Helicobacter pylori* (*H. pylori*) infection], menstruation, gastroesophageal reflux disease, Trimethylaminuria, hypermethioninemia, agranulocytosis.

Delusional halitosis:

- Pseudo-halitosis,
- Halitophobia.

Physiological halitosis, also known as morning bad breath, occurs during the night because of decreased salivation, desquamation of epithelial cells and the putrefaction of food debris. It is clinically defined as tongue coated and decreased fluid intake (23).

Delusional halitosis can be explained as the feeling of the halitosis by the subject while exhaling however, which could not be confirmed by any other people; neither a doctor nor any other person (23). Pseudohalitosis patients do not have a real source of halitosis but patients complain about the presence of oral malodor. These patients are convinced that they do not have oral malodor during diagnosis and treatment (24). Halitophobia assessed as psychosomatic disorders related to dentistry affect at least 0.5-1% of the adult population (25). Dental practitioners are able to cure pseudohalitosis, however psychological specialists have to treat halitophobic patients (26).

Pathophysiology of Halitosis

Decrease in salivary flow causes a negative effect on the self-cleaning effect of saliva and volatile compounds that cause halitosis are produced (27,28). Proteolytic bacterial growth is related to mucin precipitation and alkalization of the oral environment. Therefore, causes of the xerostomia such as mouth breathing, dehydration, salivary gland diseases and certain drugs are known as reason for halitosis (5).

Approximately 10% of patients with severe periodontitis have oral malodor (5). Periodontal and gingival inflammation is one of the main causes of halitosis (7,8). In addition, periodontal diseases associated with plaque may increase the degree of halitosis. The primary reason for the oral malodor is dorsum (29). This is why the morphology of

tongue papillae is a favorable structure for the life of microorganisms (30). *Veillonella* spp., *Prevotella* spp. and *Fusobacterium* spp. are the most common types of anaerobic bacteria in children (30).

Mucosal surface is dry due to decrease saliva in individuals who have mouth breathing. Children with halitosis were found to have mouth breathing in 40% of the cases (15).

Postnasal drip and tonsillitis from respiratory-related infections in children are common, which means more bacteria with an increase in mucus and phlegm accumulation (5). *Klebsiella ozenae* prevents the self-cleaning feature of the nasal mucosa and causes atrophic rhinitis. *Streptococcal* species cause acute pharyngitis and sinusitis to source to the formation of bad breath (18).

Gastrointestinal pathologies are the most common extraoral causes leading to oral malodor (31). The association of *H. pylori* with halitosis was suggested by Marshall et al. (32) *H. pylori* ATCC 43504, *H. pylori* SS 1, *H. pylori* DSM 4867 are *H. pylori* strain which are responsible for the production of VSCs. Other species of *H. pylori* have not been associated with oral odor since they do not produce VSCs (33). In crowded families there is a risk of cross infection. Since *H. pylori* is a carcinogenic potential, oral malodor may be an indicator for early diagnosis and treatment. Antibiotics and proton pump inhibitors are used for *H. pylori* treatment and also reduce halitosis (31).

The consumption of fragrant foods such as garlic, onions, pickles and spices can cause temporary oral malodor (21). It proposed some drugs that cause halitosis; lithium salts, penicillamine, griseofulvin, thiocarbamide, dimethylsulfoxide, ethyl alcohol, antihistaminics, diuretics, phenothiazines derivatives, tranquilizers, choral hydrate, nitrites and nitrates, amphetamines, paraldehyde, suplatatosilate, bisphosphonates, metronidazole, arsenic salts (9).

Diagnosis of Halitosis

Diagnostic methods of halitosis enable differentiation of genuine halitosis, pseudohalitosis and halitophobia. Therefore, assessment of diagnosis and severity of halitosis is important to prevent incorrect or unnecessary treatment (21).

Organoleptic Measurement

Organoleptic method is accepted as the gold standard for halitosis measurement (34). The results of organoleptic measurements showed a strong correlation with the breath VSCs levels (34). The advantages of this method are that it is cheap, that no equipment is needed and that there is a wide range of odour (2). On the other hand, the test has disadvantages such as subjectivity, nasal saturation, the lack of quantification and the repeatability of the test (2). In addition, the measurement method is unpleasant for practitioner and patient (35).

Gas Chromatography

Gas chromatograph (GC), which is an objective, reproducible and reliable method, analyses air, incubated saliva, tongue debris or crevicular fluid for VSCs (29). GC has a high specificity that can detect VSC even at low concentrations (9). In this method the measurements are carried out with instruments equipped with a flame photometric detector or mass spectrum. The concentration of VSC (10 ng/mL) is assessed on the basis of hydrogen sulfide and methyl mercaptan preparations prepared as standard (36). In practice, the patient is told to close his mouth and hold his breath for 30 seconds. After the aspiration with the help of a gas-tight syringe of breath is injected into the GC column at 70 °C various disadvantages are expensive, requires trained staff, takes up a lot of space, is not suitable for daily practice and application takes much time (37).

Sulfide Monitoring

In this method, the patient's mouth is first closed for 5 minutes. Then the disposable tubes of the device are placed in the patient's mouth and nose. At the same time when the air in the mouth is collected, the patient is asked to breathe through the nose. Sulfur components in the breath are detected by electrochemical reaction (29,38,39). This method is reproducible and easy to use. However, the ability to detect only sulfur-containing compounds can lead to an incorrect assessment of the source and intensity of oral malodor. As oral malodor may also contain substances other than VSCs (40).

Chemical Sensors

Chemical sensors and sulfur monitors have a similar working principle. The probes of chemical sensors are sulphur sensitive. Sulphur components detected by the probe produce electro-chemical voltage. The voltage measured by the electronic unit is shown as digital scores on the device's screen (41-43). Chemical sensors, also known as electronic nose, could measure ammonia, methyl mercaptan compounds and each volatile sulphur-containing compound from breath air. The sensitivity of the sensors has positive correlation to gas chromatography and organoleptic scores (29,44-47).

Indirect Measurements of the Breath Components

Salivary Incubation Test

Halitosis could be diagnosed with salivary incubation test. In this method, saliva is accumulated in a glass tube then the tube is incubated at 37 degrees in an anaerobic chamber which has 80% of nitrogen, 10% of carbon dioxide and 10% of hydrogen environment for 3-6 hour. Finally, practitioner measures the smell (21). The most important advantage of this method according to the organoleptic method is that it is less affected by external factors such as smoking, onion garlic eaten, spicy foods. Also, unpleasant measurement conditions in the organoleptic method are not found in this method. Salivary incubation test shows significant relation with organoleptic measurement (48).

Benzoyl-DL-Arginine-A-Naphthylamide Test

Benzoyl-DL-arginine-naphthylamide (BANA) test is very useful for clinical practice. Samples taken with a cotton swab from the tongue surface to detect halitosis and subgingival plaque samples taken with curette for periodontal risk assessment are placed on the BANA test strip. The samples placed in the incubator are heated at 55 °C for 5 minutes. The presence of *Treponema denticola*, *Porphyromonas gingivalis* or *Bacteroides forsythus* is proved when the test strip turns blue. There is a positive correlation between the darkness of the blue and microorganism concentration (21). While organoleptic measurements with BANA test give similar results, sulphur monitor measurements can give different results (21).

Quantifying β -galactosidase Activity

Several studies have shown that β -galactosidases are effective in the production of VSCs (49-51). Thus, measuring the efficacy of this enzyme can be used to diagnose halitosis (29,49-51). Halitosis formation begins with deglycosylation of glycoproteins (50). Glycoproteins are proteolyzed by the removal of O- and N-linked carbohydrates from side chains. One of the main enzymes responsible for this separation is β -Galactosidase (52,53).

Polymerase Chain Reaction

Gives information on the dorsum of the tongue polymerase chain reaction (PCR) microflora but the possibility determination VCS produced by the organism. When using molecular techniques, the most common species were found as *Streptococcus*, *Veillonella*, *Prevotella* and *Actinomyces*. *Streptococcus* spp. are not identified by culture methods since the culture method was used only for detection of gram negative species. Gram-positive species such as *Streptococcus* spp. can not be determined by culture methods since the culture method is only used for the detection of gram negative species. *Veillonella* and *Prevotella* species can be detected both by culture method and by molecular technique. But *Fusobacterium* is determined by the molecular method (54). PCR and culture method give similar results to a limited extent (55). Further studies are needed to understand the mechanism of VSCs production by the microorganisms identified in halitosis patients (54).

Ammonia Monitoring

In this method halitosis measurements can be made with a portable monitor that detects the amount of ammonia produced by the oral bacteria. Physicians ask patients to stop eating and drinking at least 2 hours before measurements. Then patients use the mouth rinse containing urea solution for 30 seconds and close the mouth for 5 minutes. A disposable mouth piece attached to an ammonia gas detector containing a pump that draws 50 mL of air through a tube is placed in the mouth of the patient. Ammonia measurement results are taken from the scale in the detector tube (20). Ammonia monitoring measurements show similar results with

gas chromatographic method and different results with organoleptic method (20).

Ninhydrin Method

The ninhydrin method is used for the measurement of amino acids and lamines (21). Isopropanol is added to the saliva collected from the patient and the mixture is centrifuged. Isopropanol, buffer solution (pH 5) and ninhydrin reagent are used to dilute the supernatant. The mixture is refluxed in a water bath for 30 minutes then cooled to 21.8 °C and isopropanol is added to dilute. Light absorption readings are measured with a spectrometer (21). This method is similar to organoleptic scores and sulphide monitor measurements (56).

Halitosis Associated Life-quality Test Questionnaire

Halitosis associated life-quality test (HALT) questionnaire was developed to understand the effect of halitosis on quality of life (57). In addition, this method provides a comprehensive evaluation of the physical, social and psychological negative effects of halitosis (58). HALT was created with a Likert scale of 0-5; a higher score showed a worsening and a greater impact on an individual's quality of life (57). This questionnaire consists of 20 specific items and has a maximum score of 100. In addition, the follow-up of halitosis treatment is based on the difference in scores between sessions (57). In most cases, the HALT score was higher than the organoleptic score (26).

Treatment of Halitosis

Proper diagnosis is essential for effective treatment of halitosis. If there is significant periodontal diseases and dental caries, which contribute to halitosis it should be treated. Ensuring adequate oral hygiene is the most important element for oral malodor treatment (30). Among methods of treatment are chemically and mechanically reducing the amount of microorganisms, products that mask the odor, and chemical neutralization of VSCs (59).

Although there was a decrease in the number of bacteria with toothbrushing (60), some studies did not find any difference between regular toothbrushing and oral malodor (30,34). The differences of the devices used have been declared as relation for the

percentage of VSCs, such as a normal toothbrush will be 33%, a specially designed cleaner for tongue and plus to that periodontal health status, exactly a number of 51.8% with patients with halitosis than patients without periodontal disease and also 49% to patients with periodontitis (61). İleri Keçeli et al. (30) conducted a study of toothbrushing and tongue brushing together and observed a decrease in both bacterial load and tongue coating after 2 weeks.

The primary objective of antimicrobial therapy is to reduce proteolytic, anaerobic flora on the tongue surface. Treatment management should include components such as a tongue scraper that reduce the mechanical load and antimicrobial mouth rinse that reduce the chemical load (62). Frequently used antimicrobial mouth rinse are chlorhexidine (CHX), essential oils, triclosan and cetylpyridinium chloride (CPC), metal ions and oxidizing agents (62).

The gold standard CHX is also accepted for mouth rinse used for halitosis treatment (63). Combined use of CHX and CPC resulted in both a reduction of aerobic and anaerobic bacterial load and a further decrease in VSCs level (46). In a study using a combination of zinc at 0.3% concentration and CHX at 0.025% concentration were observed to 0.16% drop at 1 hours, 0.4% drop at 2 hours, and 0.75% drop after 3 hours at H₂S levels (64). It has also been shown that consumption of daily tablets containing probiotic *Lactobacillus salivarius* WB 21 may help control factors associated with oral malodor (65).

Conclusion

Halitosis is gaining increasing importance in recent years because it affects interpersonal communication and self-expression. The literature is not enough research on halitosis. There is a need for additional, especially randomized, studies to clarify this.

Ethic

Peer-review: Internally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: Z.Ç., Concept: Z.Ç., Design: Z.Ç., Data Collection or Processing: Z.Ç., I.S., Analysis or Interpretation: Z.Ç., Literature Search: Z.Ç., I.S., Writing: Z.Ç.

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