Review Article

HALITOSIS- A REVIEW ON A COMMON SOCIAL PROBLEM

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Abstract

Halitosis also called as oral malodour or breath odour is a commonly experienced condition with a variety of etiologic factors. Although several non-oral sites have been related to oral malodour, recent data suggests that 90% of all bad breath originates form mouth itself. The etiological chain of halitosis relates to the presence of odoriferous substances in exhaled air, especially the volatile sulphur compounds (VSC) produced by bacteria. In general, intraoral conditions, like insufficient dental hygiene, periodontitis or tongue coating are considered to be the most important cause (85%) for halitosis. Therefore, dentists and periodontologists are the first-line professionals to be confronted with this problem. Appropriate diagnosis and management is required to solve this problem. The present review will focus on different aspects of halitosis, its etiology, diagnosis, clinical management and treatment. The literature, especially with randomized clinical trials, is scarce and additional studies are needed.

Key Words: - Halitosis, Microorganisms, Periodontitis

Introduction

Human breath is composed of highly complex substances with numerous variable odors which can generate unpleasant conditions like halitosis. Halitosis is a Latin word which is derived from halitus (breathed air) and the osis (pathologic alteration) [1] and it is used to describe any disagreeable bad or unpleasant odor emanating from the mouth air and breath. Foetororis, oral malodor, mouth odor, bad breath, and bad mouth odor are the other terms which are used to describe halitosis. [2]

Halitosis is a common condition which affects most of the adult population. Although various extra oral sites and causes have been suggested, 80%-90% of halitosis originates from mouth itself. [3]

Definition

Halitosis is defined as breath that is offensive to others, caused by a variety of reasons including but not limited to periodontal disease, bacterial coating of tongue, systemic disorders and different types of food. [4]

Classification

I. Based on etiology, halitosis can be divided into the following categories (Dominic *et al* 1982): [5]

i) Local factors of pathological origin
ii) Local factors of non-pathological origin
iii) Systemic factors of non-pathological origin
iv) Systemic factors of pathological origin.

II. Based on causes it can be also classified as (Bogdasarian 1986): [2]

i) Normal breath and physiologic mouth odour
ii) Odours from oral conditions
iii) Odours from Nasopharynx, Pharynx and Lungs
iv) Odours excreted via the Lungs.

III. Glickman 1894: [6]

1) Local Causes
- Pathologic, Non Pathologic
2) Systemic Causes
- Pathologic, Non Pathologic

IV. Classification of halitosis with corresponding treatment needs (Miyazaki *et al*): [7]

Classification	Treatment Need	Description
I. Genuine halitosis		Obvious malodour, with intensity beyond socially acceptable level, is perceived.
I.A. Physiologic halitosis	TN-1:	1. Malodour arises through putrefactive process within the oral cavity. Neither specific disease, nor pathologic condition that could cause halitosis is found. 2. Origin is mainly the dorsoposterior region of the tongue. 3. Temporary halitosis due to dietary factors (e.g., garlic) should be excluded.
I.B. Pathologic halitosis		
(i) Oral	TN-1 and TN-2:	1. Halitosis caused by disease, pathologic condition, or malfunction of oral tissues. 2. Halitosis derived from tongue coating, modified by pathologic condition (e.g., periodontal disease, xerostomia) is included in this subdivision.

(ii) Extraoral	TN-1 and TN-3:	1. Malodour originates from nasal, pernasal, and/or laryngeal regions. 2. Malodour originates from pulmonary tract or upper digestive tract. 3. Malodour originates from disorders anywhere in the body, whereby, the odour is blood borne and emitted via the lungs (e.g., diabetes, hepatic cirrhosis, uremia, internal bleeding).
II. Pseudo-halitosis	TN-1 and TN-4:	1. Others do not perceive obvious malodour although the patient stubbornly complains of its existence. 2. Condition is improved by counseling (using literature support, education, and explanation of examination results) and simple oral hygiene measures.
III. Halitophobia	TN-1 and TN-5	1. After treatment for genuine halitosis or pseudohalitosis, the patient persists in believing that he/she has halitosis. 2. No physical or social evidence exists to suggest that halitosis is present.

CATEGORY	DESCRIPTION
TN-1	Explanation of halitosis and instructions for oral hygiene (support and reinforcement of patients own self care for further improvement of their oral hygiene)
TN-2	Oral prophylaxis, professional cleaning and treatment for oral diseases, especially periodontal diseases.
TN-3	Referral to a physician or medical specialist.
TN-4	Explanation of examination data, further professional instruction, education and reassurence.
TN-5	Referral to a clinical pshychologist, psychiatrist or other psychological specialist.

Origin

The main etiological factor of oral malodour is proteolytic degradation of peptides present in the saliva by microorganisms in the oral cavity. Due to this process, volatile sulphur compounds (VSCs) mainly hydrogen sulphide (H_2S), methyl mercaptan (CH_3SH) and dimethyl sulphide $(CH_3)_2S$ are formed. These VSCs are mainly produced by Gram-negative anaerobic oral bacteria.[8] Other molecules involved in this bacterial degradation process are: diamines (indole and skatole) or polyamines (cadverin and putrescin) and they seem to play a less important role in the expression of bad breath. The most predominant substrates in this VSC production are cysteine, cystine and methionine.[9] The main substrate for skatole and indole production is tryptophan, whereas lysine and ornithine are the basis for the putrescin/cadaverin production.

Volatile molecules contributing to oral malodour [9]

Volatile sulphur compounds	Methyl mercaptan: CH_3SH Hydrogen sulphide: H_2S Dimethyl sulphide: $(CH_3)_2S$
Diamines	Putrescine: $NH_2(CH_2)_4NH_2$ Cadaverine: $NH_2(CH_2)_5NH_2$ Butyric acid:$CH_3CH_2CH_2COOH$ Propionic acid: $CH_3CHCOOH$ Valeric acid:$C_5H_{10}O_2$
Phenyl compounds	Indole: C_8H_7N Skatole: C_9H_9N Pyridine: C_5H_5N
Alcohols	1-propoxy-2-propanol
Alkalines	2-methy-propane
Nitrogen-containing compounds	Urea: $(NH_2)_2CO$ Ammonia: NH_3
Ketones	

Bacteria responsible for VSC production [10]

Volatile sulphur compounds	Bacteria
H_2S from cysteine	Peptosteptococcusanaerobius Micros prevotii Eubacteriumlimosum Bacteroides spp. Centipediaperiodontii
H_2S from serum	Prevotellaintermedia Prevotellaloescheii Porphyromonasgingivalis (BANA positive) Treponemadenticola (BANA positive) Selenomonasartermidis

CH_3SH from methionine	Fusobacterium nucleatum Fusobacteriumperiodonticum Eubacterium spp. Bacteroides spp.
CH_3SH from serum	Treponemadenticola (BANA positive) Porphyromonasgingivalis (BANA positive) Porphyromonasendodontalis
Others	Prevotellamelaninogenica Tanerellaforsythensis Eikenellacorrodens Solobacteriummoorei Treponemaforsythensis Centipedaperiodontii Atopobiumparvulum

Etiology

Oral causes

- Tongue coating – It is the most common cause of bad breath .The dorsum of the tongue, which is irregular and has a surface of 25 cm^2 is an ideal niche for oral bacteria.[11]
- Morning breath-Due to the reduced saliva production during night, anaerobic putrefaction will increase, causing the typical morning breath.
- Odontogenic halitosis-Poor oral hygiene, dental plaque, dental caries, accumulation and putrefaction of food remnants and unclean acrylic dentures contribute to bad breath. Gingivitis and periodontitis are the main causes of the problem.
- Xerostomia- The lack of salivary flow leads to the reduction of the antimicrobial activity of the saliva and the transition from Gram-positive bacteria to Gram-negative species. Also an increase of the salivary pH by the intake of amino acids, and a change in the oxygen depletion can lead to malodour.[12]
- Other oral causes- Stomatitis, intra-oral neoplasia, exposed tooth pulps (with necrotic content), extraction wounds (with blood cloth or purulent discharges), or crowding of teeth (favouring food entrapment) can also be involved.[13] Moreover, peri-implantitis, peri-coronitis, recurrent oral ulcerations and herpetic gingivitis, are described as source for bad breath.

ENT and pulmonary pathology

- Maximally 10% of the oral malodour cases originate from the ears, nose and throat (ENT) region, from which 3% finds its origin at the tonsils.[14] The presence of tonsilloliths, represents a 10-fold increased risk of abnormal VSC levels.[15]
- Nasal causes-Postnasal drip (caused by mucus of the paranasal sinuses) contacting the dorsum of the tongue[16] and foreign bodies in the nasal cavity can produce a foul odour.
- Sinusitis can also lead to halitosis due to VSC production.
- Pulmonary pathology-bronchiectasis, lung abscesses and other endobrochial chronic disorders, i.e. necrotizing pulmonic neoplasias may cause a disagreeable odour.

Gastro intestinal pathology

- Oesophagus-Only in specific cases, such as in Zenker's diverticulum, a chronic unpleasant odour appears.[17] Bleeding of the oesophagus can also cause a musty odour.
- Stomach-Infections with Helicobacter pylori can cause peptic ulcers. Lee *et al*[18] confirmed that significant VSC are produced by H. pylori. Moreover, it is suggested that H. pylori was detected in subjects with periodontitis, suggesting that progression of periodontal pocket and inflammation may favour colonization by this species and that H. pylori infection may be indirectly associated with oral pathological halitosis following periodontitis.
- Intestines-In cases of intestinal obstruction, a faecal mouth odour maybe detectable.

Metabolic disorders

- Renal disease in the form of chronic renal failure is associated with high blood urea nitrogen levels and low salivary flow rates. The dispersed odour is a typical uremic odour in combination with a dry mouth.
- Diabetic ketoacidosis leads to a typical breath odour. Type 2 diabetes demonstrates a typical sweet and fruity odour.[19]
- Trimethylaminuria is a disorder in which the volatile, fish-smelling compound, trimethylamine accumulates and is excreted in the urine, and is also found in the sweat and breath. So patients suffering from this metabolic disorder will have a fishy odour.
- Pancreatic insufficiencies can also cause oral bad odours.[20]

Hepatology and endocrinology

- 'Fetor hepticus': a sweet, excremental odour (the breath of death) can originate from liver in cases of hepatic encephalopathy. Due to a reduced liverfunction, waste products are eliminated through the lungs producing this particular odour.

Odours in the case of metabolic or endocrinological problems[19]

Fruity odour	Type-1-diabetes in children Type-2-diabetes in adults Alcoholic ketoacidosis
Faecal odour	Intestinal obstruction
Ammonia of fishy odour	Kidney-insufficiency Trimethylaminuria
Mouse odour	Phenylketonuria
Cooked cabbage odour	Methionine adenosyltransferase deficiency
Sweating feet odour	Isovaleriaan acidity Deficiency on chromosome 15
Burned sugar odour	Maple syrup urine disease

Sweet musty odour	Homocystinuria
Rotten eggs odour	Disease of Lignac

Medication

Studies have shown that the use of bisphosphonates can cause jawbone necrosis, and is a clear origin for a filthy odour.

Clinical Management

DIAGNOSIS

Self-assessment

The patient cannot smell his own breath and relies upon others for this information. The patient should therefore be emphasized that self-assessment is always the best for diagnosis of oral malodour.

Spoon test

The spoon test is used to assess halitosis originating from the posterior part of the dorsum of the tongue.[21] A sterile plastic spoon is used to scrape the dorsum of the tongue. After about 5 seconds, the odor from the contents of the spoon is assessed, holding the spoon about 5cms away from the nose.

Dental floss odor test

This test is used to assess the odor originating from the inter-dental regions. The examiner passes a sufficient length of un-waxed floss through the inter-dental regions of posterior teeth. The odor is assessed by holding the floss about 3 cms from the nose.

Saliva odor test

The patient is instructed to expectorate about 1-2 ml of saliva into a glass tube. The tube is covered immediately and incubated at 37^0 C for five minutes. The glass tube is then held about 4cms away from the nose for assessing odor.[22]

Organoleptic measurements

The human nose remains the "Gold Standard" in detecting oral halitosis. The most widely used scoring system for ranking halitosis is the Organoleptic Score popularized by Rosenberg and McCulloch.[23] When organoleptical scoring is performed, a well-trained clinician determines if the odour samples smells bad or not, giving a score to the intensity.

Theses scores range from 0 up to 5

Organoleptical scoring [23]

Rosenberg & McCulloch scale	Description
0	No detectable odour
1	Hardly detectable odour
2	Light odour
3	Moderate odour
4	Strong odour
5	Extremely strong odour

From every patient, different samples are analysed:

- Mouth odour (smelled at 10 cm from the oral cavity: while the patient normally breaths and while the patient counts loudly to10);
- Saliva odour (measured by the wrist-lick test: the patient licks at the wrist, and after 10 s of drying, a score is given to this sample);
- Tongue coating (a score is given to debris, scraped from the dorsum of the tongue with a periodontal probe);interdental 'floss' (after flossing with dental tape, the odour of the floss is scored);
- Nasal odour (while the patient is breathing through the nose(mouth closed), a score is given to the exhaled air);
- Prosthesis odour (if the patient wears a partial or full removable denture, scoring of the odour of this prosthetic is noted).

The advantages of organoleptical scoring are: inexpensive, no equipment needed and a wide range of odours is detectable. As disadvantages, the extreme subjectivity of the test, the lack of quantification, the saturation of the nose and the reproducibility can be mentioned[3].Still, organoleptic scoring is considered as the gold standard in the detection of oral bad breath.

Portable gas analysis

The Halimeter (Interscan Corporation, Chatsworth, CA, USA) and Oral Chroma (Abimedical Corporation, Miyamae-ku Kawasaki-shi, Kanagawa, Japan) are electronic devices available to detect some of the volatile sulphur components in expired air.
These portable machines have a lot of advantages: easy to handle, fast results, portable and reproducible. Furthermore, they are rather inexpensive and can be controlled by untrained staff. As disadvantage, the limited diversity in the explored gasses should be stated.

Gas chromatography

In halitosis research, the gas chromatography (GC) analysis can be performed on breath, saliva and tongue debris. Almost all different air components can be detected.

Advantages: High sensitivity and specificity, non-invasive.

Disadvantages: expensive and a well-trained staff is needed.

Microbiologic tests

An alternative strategy to assess halitosis is to detect the microorganisms and their enzymes which can produce VSCs. Three species associated with periodontal disease, Treponemadenticola, Porphyromonas gingivalis and Tannerellaforsythia, produce both VSC and volatile fattyacids and can be detected by the presence of an enzymes that degrades benzoyl-DL-arginine-naphthylamide (BANA), a synthetic trypsin substrate, forming a colored compound 5 to 10 minute chair-side test – the BANA Test.

Therapy

Oral causes

Since the oral causes are related to microorganisms, the therapy can consist of: (i) mechanical reduction of the intra-oral nutrients and micro-organisms; (ii) chemical reduction of microorganisms; (iii) inverting volatile fragrant gases into non-volatile components or (iv) masking of the malodour. [24]

Mechanical reduction

Tongue coating is the most prominent factor and therefore, extensive tongue cleaning especially scraping of the dorsum of the tongue reduces the available microorganisms, leading to an improvement of the odour. Van der Sleen *et al* demonstrated that tongue brushing or tongue scraping have the potential to successfully reduce breath odour and tongue coating. A one-stage full-mouth disinfection, as described by Bollen *et al* combining scaling and root planning in combination with chlorhexidine, has a significant microbiological improvement up to 2 months and reduces the organoleptical scores, in particular for saliva samples.[25]

Chemical reduction

Rinsing the oral cavity can be done with the following components help to reduce oral malodour.

- Chlorhexidine (CHX): CHX is the most efficient molecule against plaque. Rosenberg showed that rinsing with 0.2% CHX causes a reduction of 43% in VSCs and of 50% in the organoleptical scores on a day-long basis.[26]
- Essential oils: these products give only a short-term and restricted effect (25% reduction) for 3 h.
- Chlordioxide: chlordioxide is a strong oxidizing product that can reduce oral malodour by the oxidation of H_2S, CH_3SH, cysteine and methionine. A reduction of 29% in odour after 4 h was reported.[27]
- Triclosan: triclosan is effective against the majority of oral bacteria. And 84% reduction of VSCs after 3 h is proved
- Aminefluoride/tinfluoride: the combination of AmF/SnF2 can cause an 83% reduction in the morning halitosis.
- H_2O_2: a concentration of 3% of this product can result in a 90%VSC reduction after 8h

Transformation of volatile sulphur components

Metal ions with affinity for sulphur; pick up sulphur-containing gasses. Zinc, mercury and copper is the most important metals. A commercial rinse (containing 0.005% CHX, 0.05% cetylpyridinium chloride (CPC) and 0.14% zinc lactate) seems to be much more efficient than CHX alone, due to the effect of zinc. Zinc plus CHX seem to have a synergistic effect.[28]

Masking effect

The use of chewing gum may decrease halitosis, especially through increasing salivary secretion mouth rinses containing chlorine dioxide and zinc salts have a substantial effect in masking halitosis, not allowing the volatilization of the unpleasant odour.[29]

Medical approaches

If oral approaches are not successful in reducing/eliminating halitosis, patients should be referred to otorhinolaryngologist, followed by the gastroenterologist. If halitophobia is considered, a psychologist or phsychiatrist should be included.[30]

Conclusion

This article highlights on the possible causes and the various management modalities of halitosis patients.This aspects are very useful for general practitioners, especially with regard to patients with pseudohalitosis, who may seek treatment from them. Evaluation of the psychological condition of patients with halitosis is important and needs multidisciplinary approach.

References

1. Hine KH. Halitosis. J Am Dent Assoc 1957;55:37–46.
2. Bogdasarian RS. Halitosis. Otolaryngologic Clin North Am 1986;19:111–17.
3. Tonzetich J. Production and origin of oral malodor: A review of mechanisms and methods of analysis. J Periodontol 1977;48(1):13-20.
4. American Academy of Periodontology. Glossary of Periodontal Terms. 4th ed. Chicago: American Academy of Periodontology; 2001. 56 p.
5. Lu DP. Halitosis: an etiologic classification, a treatment approach, and prevention. Oral Surg Oral Med Oral Pathol 1982:54(5):521-526.
6. Glickman,I. Clinical periodontology.in: ed. 4. W. B. Saunders Company, Phyladelphia; 1972:401
7. Miyazaki H, Arao M, Okamura K, Kawaguchi Y, Toyofuku A, Hoshi K *et al*. Tentative classification of halitosis and its treatment needs. Niigata Dent J 1999; 32:7-11. *Japanese*
8. Krespi YP, Shrime MG, Kacker A. The relationship between oral malodour and volatile sulphur compound producing bacteria. Otolaryngol Head Neck Surg 2006;135(5):671–676.
9. Goldberg S, Kozlovsky A, Gordon D, Gelernter I, Sintov A, Rosenberg M. Cadaverine as a putative component of oral malodour. J Dent Res 1994;73(6): 1168-72.
10. Persson S, Edlund MB, Claesson R Carlsson J. The formation of hydrogen sulphide and methyl mercaptan by oral bacteria. Oral Microbiol Immunol 1990;5(4):195–201.
11. Collins LM, Dawes C. The surface area of the adult human mouth and thickness of the Salivary film covering the teeth and oral mucosa. J Dent Res 1987;66(8):1300–1302.
12. Iwanicka-Grzegorek K, Lipkowska E, Kepa J, Michalik J, Wierzbicka M. Comparison of ninhydrin method of detecting amine compounds with other

methods of halitosis detection. Oral Dis 2005;11(Suppl 1):37–39.
13. Prahabita PK, Bhat KM, Bhat GS. Oral malodor: a review of the literature. J Dent Hyg 2006;80(3):8.
14. van den Broek AM, Feenstra L, de Baat C. A review of the current literature on aetiology and measurement methods of halitosis. J Dent 2007;35(8):627–635.
15. Fletcher SM, Blair PA. Chronic halitosis from tonsilloliths: a common etiology. J La State Med Soc 1988;140(6):7–9.
16. Amir E, Shimonov R, Rosenberg M. Halitosis in children. J Pediatr 1999;134(4):338–343.
17. Stoeckli SJ, Schmid S. Endoscopic stapler-assisted diverticuloesophagostomy for Zenker's diverticulum: patient satisfaction and subjective relief of symptoms. Surgery 2002;131(2):158–162.
18. Lee H, Kho HS, Chung JW, Chung SC, Kim YK. Volatile sulphur compounds produced by Helicobacter pylori. J Clin Gastroenterol 2006;40(5):421–426.
19. Van Steenberge D. Endocrinological aspects. In: van Steenberghe D, editor. *Ademgeur*. Houten: Prelum Uitgevers, 2009:107–115.
20. Feller L, Blignaut E. Halitosis: a review. J South African Den Assoc 2005;60(1):17–19.
21. Hartley G, El-Maaytah, M, Greenman J. Tongue microflora of subjects with low and high malodour levels. J Dent Res. 1995;74:587
22. Kleinberg I, Westbay G. Salivary and metabolic factors involved in oral malodor formation. J Periodontol. 1992; 63(9):768-75
23. Rosenberg M, McCulloch CA. Measurement of oral malodor: current methods and future prospects. J Periodontol 1992;63(9):776-82.
24. Bradshaw DJ, Perring KD, Cawkill PM, Provan AF, McNulty DA, Saint EJ *et al*. Creation of oral care flavours to deliver breath-freshening benefits. Oral Dis 2005;11(Suppl 1):75–79.
25. Quirynen M, Zhao H, Soers C, Dekeyser C, Pauwels M, Coucke W *et al*. The impact of periodontal therapy and the adjunctive effect of antiseptics on breath odour-related outcome variables: a double-blind randomized study. J Periodontol 2005;76(5):705–712.
26. Rosenberg M, Gelernter I, Barki M, Bar-Ness R et al. Day-long reduction of oral malodour by two phase oil: water mouthrinse as compared to chlorhexidine and placebo rinses. J Periodontol 1992;63(1):39–43.
27. Frascella J, Gilbert R, Fernandez P. Odor reduction potential of a chlorine dioxide mouthrinse. J Clin Dent 1998;9(2):39–42.
28. Young A, Jonski G, Rolla G. Inhibition of orally produced volatile sulphur compounds by zinc, chlorhexidine or cetylpyridinium chloride—effect of concentration. Eur J Oral Sci 2003;111(5):400–404
29. Rösing CK, Gomes SC, Bassani DG, Oppermann RV. Effect of chewing gums on the production of volatile sulfur compounds (VSC) *in vivo*. Acta Odontol Latinoam 2009;22(1):11-4.
30. Kinberg S, Stein M, Zion N, Shaoul R. The gastrointestinal aspects of halitosis. Can J Gastroenterol 2010;24(9):552- 6.

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