



Characteristics of 2000 patients who visited a halitosis clinic

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Abstract

Clinical

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Periodontology

Aims: The aim of this paper was to analyse the aetiology and characteristics of 2000 patients who visited a multidisciplinary bad breath clinic in Leuven, Belgium and to correlate organoleptic ratings with portable device measurements.

Materials and Methods: The characteristics and aetiology of breath malodour of two thousand consecutive patients who visited a halitosis consultation were explored by means of a standard questionnaire and a clinical examination, including organoleptic scores provided by a trained and calibrated judge, and a portable bad breath detector (Halimeter[®]).

Results: Most patients came without referral and had complaints for several years (mean: 7 years, SD: 8 years). For 76% of the patients, an oral cause was found [tongue coating (43%), gingivitis/periodontitis (11%) or a combination of the two (18%)]. Pseudo-halitosis/halitophobia was diagnosed in 16% of the cases; and ear, nose and throat/extra-oral causes were found in 4% of the patients. Most patients had an organoleptic score <3 and a Halimeter[®] value <240 p.p.b.

Conclusions: Even though it was observed that halitosis has a predominantly oral origin, a multidisciplinary approach remains necessary to identify ear, nose and throat or extra-oral pathologies and/or pseudo-halitosis/halitophobia.

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Halitosis is a general term used to define an unpleasant odour emanating from the breath. In most cases (80-90%), breath malodour has an oral origin, resulting from the degradation of organic substrates by anaerobic bacteria, and thereby producing a range of volatiles of which the sulphur compounds are the most extensively studied (Tonzetich 1977, Delanghe et al. 1997). However, bad breath can also have an extra-oral origin, thus becoming a problem that crosses over many scientific and clinical disciplines. A wide range of non-oral causes have been reported, including ear-nose-throat (ENT) infections; infections, ulcerations and tumours in the

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respiratory or gastrointestinal tract; certain systemic diseases; metabolic disorders and carcinomas (Preti et al. 1995, Delanghe et al. 1997, Tangerman 2002, Porter & Scully 2006).

There is a considerable amount of research regarding halitosis. In the Western world, however, there is a relative lack of good clinical data describing the aetiology and characteristics of bad breath for large groups of patients. One of the key studies in this field, determining the cause and characteristics of halitosis in 260 patients, was published by Delanghe et al.(1997).

Ten years ago, a multidisciplinary consultation for breath odour (Periodontology, Internal Medicine, ENT and Psychiatry) was implemented at the University Hospital Leuven, Belgium. Since then, more than 2000 primarily Caucasian patients complaining of halitosis were examined by the same clinician (V.B.). These examinations have led to the development of a large database. The aim of this paper was to analyse the aetiology and characteristics of halitosis of a large group of patients, and to correlate organoleptic ratings with portable device measurements (Halimeter[®], Interscan).

Materials and Methods

Subject selection

This analysis includes the data collected from the first 2000 consecutive patients who visited the multidisciplinary breath odour clinic (University Hospital Leuven, Belgium) between 1995 and 2008. Before examination, patients received a letter with instructions. They were asked not to eat garlic, onions or spicy food for 2 days before their appointment. They were also instructed to refrain from drinking alcohol or coffee, and from smoking during the 12-hour period before their appointment. On the morning of the appointment, patients were asked not to use chewing gum, mints, drops, scents or mouth rinses. Toothbrushing with water and breakfast were allowed in order to avoid confusion between breath malodour and morning bad breath. All measurements were recorded between 8:30 and 11:30 hours, and at least 2 h after eating or drinking or oral hygiene. Previous studies using gas chromatography have shown that sulphur levels decrease to a lower level after breakfast, and that they remain steady over a period of at least 7 h afterwards (Suarez et al. 2000). The complete examination of each patient did not take longer than 30 min.

Patients were examined by a periodontologist (V.B.). Whenever the organoleptic assessment or the questionnaire (see below for more details) pointed to an extra-oral cause of halitosis, patients were also examined by an ENT specialist or an internist/psychiatrist was called in.

Questionnaire

Each examination began by asking the patients some specific questions about their breath malodour; duration, evolution, daily pattern and whether the observation or complaint was being made by the patient himself or by others. Patients were also asked about their habits (smoking, drinking and diet) and medication. A medical history was recorded for each patient, paying special attention to systemic diseases that may compromise the lungs, liver, kidneys, stomach and/or pancreas. Moreover, a specific ENT history was also carried out. Patients were asked whether they had experienced nasal obstruction/discharge, mouth breathing, post-nasal drip, allergies, tonsil problems, dysphagia, voice problems and whether they had undergone ENT treatment. Finally, the patients' oral hygiene habits were recorded: frequency of toothbrushing, inter-dental cleaning, tongue brushing or scraping, use of removable appliances and frequency of dental visits.

Clinical examination

The oral cavity was examined, paying attention to caries, plaque accumulation, gingival inflammation, periodontal pockets, removable appliances and tongue coating. The latter was scored by means of a visual inspection from 0 to 3, with 0 = no coating, 1 = thin coating on 1/3 of

Organoleptic assessment

Organoleptic scores were determined by a trained and calibrated judge who had previously tested her ability to distinguish odours using the Smell Identification Test^(R) (Sensonics Inc., Haddon Heights, NJ, USA), and to detect odours at low concentrations using a series of dilutions of the following substances: skatole, putrescine, isovaleric acid and dimethyl disulphide (Doty et al. 1984).

Breath was scored as described by M. Rosenberg (1996): at rest (open mouth without breathing) and while the patients counted from 1 to 11. The latter score was the one used for the statistics described below. The judge also smelled nasal breath and a tongue coating sample. The organoleptic assessment preceded all other measurements in order to avoid any bias.

The scores were determined using the "0–5 Rosenberg scale", where 0 represented absence of odour; 1, barely noticeable odour; 2, slight malodour; 3, moderate malodour; 4, strong malodour; and where 5 represented severe malodour (Rosenberg & McCulloch 1992). In this six-point system, 0 indicates the concentration of odourant below a threshold, 1–4 are indicators of an increasing occupancy of receptor-binding sites, and 5 is assumed to be close to saturation (Greenman et al. 2005).

Halimeter[®] measurements

Mouth air was examined with a portable device (model RH-17E, Halimeter[®], Interscan Corporation, Chatsworth, CA, USA), as described previously (Rosenberg et al. 1991). Measurements were carried out by inserting a disposable tube into the subject's mouth, above the posterior part of the dorsum of the tongue without touching the oral mucosa or the tongue. The subject kept the mouth slightly open and was not allowed to breathe during sampling.

Statistical analysis

A Mann–Whitney *U*-test was used to test the differences between males and females for the organoleptic score and Halimeter[®] values. Correlations were tested using a Spearman's correlation coefficient. A Tukey–Kramer test was used to find out whether the Halimeter[®] values (log transformed) differed significantly among the organoleptic scores.

Results

Descriptive information (Fig. 1)

Thus far, the data of the first 2000 consecutive patients who visited the breath odour clinic have been analysed. There were slightly more females (n = 1078,53.9%) than males. Patient age ranged from 2 to 90 years (mean: 39.2; SD: 14.2). Almost 4% of the patients were under the age of 15. There was no significant difference in age distribution between men and women (p = 0.87, Fig. 1a). Only a small portion of the patients (13.7%) were smokers. Most patients (71.4%) came to the consultation spontaneously: 13.0% were referred by a general practitioner; 5.3%, by a dentist; and 10.3%, by an oral/medical specialist. A minority of patients (8.2%) had only recent complaints of breath malodour (<1 year), while more than 1/3had complaints for over 5 years (16% even more than 15 years, Fig. 1b). Most patients did not notice the malodour themselves, but were informed of it by others (Fig. 1c).

Cause of halitosis (Table 1)

In the majority of the cases (75.8%), the cause of halitosis was found to be oral with tongue coating being the most frequent (43.4%). In only a small portion of the patients, gingivitis or periodontitis was determined as the sole causing factor (3.8% and 7.4%, respectively). A combination of both tongue coating and gingivitis/periodontitis was detected in 18.2% of the cases. Out of the other oral causes, xerostomia was the one mostly found (2.5%). Almost 2% of the patients had an ENT cause, with tonsillitis being the most frequently seen. In approximately 2% of the patients, bad breath had an extra-oral origin with a wide variety of pathologies; and for 0.8% of the patients, no cause could be identified. For a significant group of patients (15.7%), no objective signs of malodour could be determined (pseudohalitosis-halitophobia). More than 2/3 of these patients were women.

Halitosis measurements (Fig. 2)

Most patients showed an organoleptic score <3. For a small group (4.5%), an organoleptic assessment could not be performed because of interference from



Fig. 1. General characteristics: age of patients (a), duration of complaint (b) and who is complaining (c) (Env, environment; Pat, patient himself).

other odours, such as smoke and cosmetics. The organoleptic score was slightly higher for males (mean: 1.6, SD: 1.3) than for females (mean 1.3, SD: 1.3) (p = 0.001). The Halimeter[®] values were also significantly higher for male (mean: 161 p.p.b., SD: 169) than for female patients (mean: 141 p.p.b., SD: 161; p = 0.006).

Correlations

A significant correlation was found between the organoleptic scores and the Halimeter[®] values (R = 0.51; p < 0.001) (Fig. 3). Significant differences were found for the Halimeter[®] values between organoleptic score 0 and 1 (p < 0.001), score 1 and 2 (p = 0.04)and between score 2 and 3 (p < 0.001)but not between scores 3, 4 and 5.

Significant correlations were also found between the organoleptic scores and tongue coating and pocket probing depth (R = 0.52 and 0.33, respectively; p < 0.001) and between the Halimeter[®] values and these two parameters (R = 0.47 and 0.31, respectively; p < 0.001).

Discussion

Since 1995, more than 2000 patients have visited our multidisciplinary breath malodour consultation. For this paper, the data of the first 2000 consecutive patients have been used. According to the authors' knowledge, it is the first time that the aetiology and characteristics of halitosis have been studied by the same clinician (i.e. in a standardized way), and for a group of patients as large as this one, consisting of primarily Caucasians.

Among the patients, there were slightly more women than men. It had already been observed that women seek treatment more often than men do (Miyazaki et al. 1995). Consistent with other investigations, no difference in age distribution between females and males was found, and no association between age and breath malodour was noticed (Miyazaki et al. 1995). Most patients came spontaneously, had already been having complaints for several years and had looked for help at different places. This indicates that there is still a lack of information not only among the general population but also among doctors and dentists. This reality has been reinforced by the fact that a significant group of patients had undergone a completely unnecessary gastroscopy or other medical intervention when seeking treatment for their breath malodour.

In 76% of our patients, an intra-oral cause was detected, with tongue coating being by far most frequently seen. The significance of tongue coating for halitosis has also been observed in previous studies, where high correlations between tongue coating and odour formation have been found (Coil & Tonzetich 1992, Rosenberg 1996).

For a small portion of our patient population, gingivitis or periodontitis was identified as the only causal factor for bad breath. The relevant literature indicates disagreement as to what extent oral malodour and periodontal disease are related. Several studies have demonstrated the existence of a relationship between periodontitis and halitosis. However, not all patients with gingivitis or periodontitis experience bad breath, just as not all patients with bad breath suffer from gingivitis or periodontitis (Bosy et al. 1994, Stamou et al. 2005, Rosenberg 2006). Studies also suggest that patients with periodontitis have markedly increased tongue coating (Yaegaki & Sanada 1992). In our study, a combination of tongue coating and periodontal disease could be observed in approximately 20% of the patients.

For a small part of the halitosis population, an extra-oral cause, such as

	Female		Male		Population
	n	%	n	%	%
Oral					
Tongue coating	452	41.9	416	45.1	43.4
Gingivitis	46	4.3	29	3.1	3.8
Periodontitis	62	5.8	86	9.3	7.4
Combination (tongue coating/	184	17.1	179	19.4	18.2
gingivitis/periodontitis)					
Xerostomia	26	2.4	24	2.6	2.5
Teeth related	2	0.2	5	0.5	0.4
Candida	2	0.2	2	0.2	0.2
		71.8		80.4	75.8
ENT					
Tonsillitis	10	0.9	4	0.4	0.7
Rhinitis	6	0.6	5	0.5	0.6
Sinusitis	1	0.1	3	0.3	0.2
Nose obstruction	4	0.4	4	0.4	0.4
		1.9		1.7	1.9
Extra-oral					
Gastro-intestinal	16	1.5	10	1.1	1.3
Trimethylaminuria	1	0.1	0	0	0.1
Other diseases	1	0.1	4	0.4	0.3
Medication	2	0.2	0	0	0.1
Hormonal	2	0.2	0	0	0.1
Diet	7	0.6	2	0.2	0.5
		2.7		1.7	2.3
Combination					
Combination ENT/oral cause	18	1.7	24	2.6	2.1
Combination GI/oral cause	16	1.5	17	1.8	1.7
		3.2		4.4	3.8
Halitophobia, pseudo-halitosis	211	19.6	102	11.1	15.7
Unknown	9	0.8	6	0.7	0.8

for example an ENT-pathology, was identified; confirming the important role played by the multidisciplinary team at the halitosis consultation. This percentage, however, is rather low, highlighting the main role of dentists, in both diagnosis and therapy.

The term pseudo-halitosis is used when no breath malodour can be perceived, and yet the patient is convinced that he suffers from it. If after a diagnosis of pseudo-halitosis the patient still believes that there is bad breath, one can speak about halitophobia (Yaegaki & Coil 2000).

Even when our 2000 patients do not represent the general population because they have actually looked for help for their halitosis problem, it must be noticed that the proportion of patients with pseudo-halitosis or halitophobia has grown over the years. Our first 1997 report did not include this group of patients, probably because pseudohalitosis or halitophobia were not yet recognized as such (Delanghe et al. 1997). By 2005, a second analysis of the data corresponding to the first 1000 patients showed that the pseudo-halitosis/halitophobia rate was 7.6% (Vandekerckhove et al. 2005), Pseudo-halitosis reaching 15.7% for the current 2000patient series.

One possible reason for the increase in the percentage of patients with imaginary halitosis is the high amount of advertising regarding fresh breath, which is now available through the media, especially the Internet. It is not infrequent that patients notice a bad taste in their mouth, and wrongly assume they have breath malodour. Bad taste can be further strengthened when tonsil stones (tonsilloliths), which smell very bad, but do not necessarily give rise to halitosis, are coughed up (Pruet & Duplan 1987).

Consistent with previous findings, 2/3 of the halitophobics were women (Seemann et al. 2006). Women were also the hardest to convince about their wrong feeling. Forty-five percent of the female and 32% of the male pseudo-halitosis patients could not notice any difference

in the way they felt about the problem on a follow-up visit. In these cases, psychiatric advice is desirable. Halitophobia is now a recognized psychiatric condition (Lochner & Stein 2003).

The higher proportion of female halitophobics helps to partly explain the significantly higher organoleptic scores and Halimeter[®] values observed for men, although some previous studies have also mentioned some kind of relationship between gender and halitosis levels (Rosenberg & Leib 1995, Morita & Wang 2001).

In accordance with other studies, a significant correlation was found between the organoleptic score and the Halimeter[®] values (Rosenberg et al. 1991, Oho et al. 2001). However, no significant difference could be found for the Halimeter[®] values among organoleptic scores 3-5 (Fig. 3). One of the reasons for this might be that the proportion of patients diagnosed with periodontitis or gingivitis was much higher in these groups than in the overall study population (organoleptic score 5: 54%; organoleptic score 4: 45%). Previous studies have shown that the methyl mercaptan/hydrogen sulphide ratio is increased in patients with periodontitis (Coil & Tonzetich 1992). Because Halimeter[®] is much less sensitive to methyl mercaptan than to hydrogen sulphide, the VSC levels might be underestimated in these patients (Furne et al. 2002). Even when it is known that this device has some limitations, it has been available since the time consultations started; and although it lacks perfect accuracy, it has proven to be a useful adjunct tool for the diagnosis of oral malodour (Vandekerckhove et al. 2009).

Although subjective, the organoleptic scores are to date the gold standard for the diagnosis of halitosis. One could argue that the calibration of the judge performing the evaluation was insufficient because none of the most recognized volatile compounds were included in the calibration set. Unfortunately, few data have been published on methods for training oral malodour judges. Nachnani et al. (2005) have demonstrated the improvement of training odour judges using skatole, putrescine, DMS and butyric acid. Greenman et al. (2004, 2005) have suggested the use of a set of odourants that should include acids. amines and skatole to standardize odour judges.



Fig. 2. Organoleptic scores (while speaking) and volatile sulphur compounds levels (Halimeter^(R)) for male and female patients.



Fig. 3. Halimeter[®] values according to the organoleptic score.

A majority of patients came to the consultation only once. Forty-one per cent of the patients came back for a follow-up visit. Seventy-nine percent of them had completely resolved their breath malodour problem or had experienced a significant improvement. This indicates that in most of the cases, genuine halitosis can be easily resolved with adequate treatment. For oral malodour, the treatment should focus on proper oral hygiene instructions, tongue scraping and inter-dental cleaning. If necessary, professional periodontal therapy should be performed (van Steenberghe & Quirynen 2003). In approximately 10% of the patients, no improvement whatsoever could be seen on their second visit. This could be due to a lack of compliance with the oral hygiene instructions or an undetected underlying problem.

This large-scale study shows that in most Caucasian patients complaining of halitosis, there is an intra-oral origin. However, there is a small group of patients with an extra-oral cause, and a growing percentage of patients with halitophobia, which should not be underestimated. Thus, a multidisciplinary approach remains the method of choice to come to the right diagnosis and treatment for each individual patient.

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Clinical Relevance

Scientific rationale: The first 2000 consecutive, primarily Caucasian patients with halitosis complaints were examined by the same clinician leading to the development of a large and unique database.

Principal findings: Most patients came to the clinic spontaneously.

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An oral cause of halitosis was most frequently diagnosed, followed by pseudo-halitosis/halitophobia. A significant correlation was found between the organoleptic score and Halimeter[®] values and between them and the tongue coating and pocket probing depth. ing a multidisciplinary breath odor clinic at a university hospital. *Oral Diseases* **11**, 98–99.

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Practical implications: The medical community still lacks knowledge about the subject. Pseudo-halitosis/ halitophobia is growing. Even though it presents some limitations, Halimeter[®] is a useful adjunct tool for the diagnosis of oral malodour.

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