RESEARCH ARTICLE
DOI: 10.26650/Tr-ENT.2023.1344644
The Turkish Journal of Ear Nose and Throat

Concha Bullosa as a Cause of Rhinological Halitosis

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Citation: Yilmaz E, Kesimli MC, Altundag A. Concha bullosa as a cause of rhinological halitosis. Tr-ENT. Advance Online Publication. https://doi.org/10.26650/Tr-ENT.2023.1344644

ABSTRACT

Objective: Sinonasal diseases are one of the main causes of foul breath. Disruption of mucus drainage leading to bacterial putrefaction is the leading factor of volatile organic compounds (VOCs) production. Concha bullosa (CB) is also one of the factors affecting mucus drainage. Its effect on foul breath was investigated in this study.
Materials and methods: Sixty patients were included in the study. The participants were selected from those complaining of halitosis, who have CB formation on at least one side, and pathologic VOCs, hydrogen sulfide, methylmercaptan, and dimethylsulfide levels in their OralChroma measurements. The patients were divided into two groups. Surgery was applied to 32 patients, and no treatment was given to 28 patients. The VOCs levels were evaluated using OralChroma.
Results: Sixty patients with a mean age of 36.5 years were included in the study. Before and after the operation of concha bullosa and also when the surgical group and control groups were compared, the decrease in methylmercaptan values was shown to be statistically significant ($p<0.05$).
Conclusion: Concha bullosa should be considered in the etiology of halitosis in cases with no determined cause and high methylmercaptan values.
Keywords: Halitosis, concha bullosa, VOCs, oral chroma, methyl mercaptan

INTRODUCTION

Halitosis, a medical term for foul breath, is a problem that negatively affects the social life of many individuals (1). Its etiology is classified into two groups, as intraoral and extraoral pathologies, where the former makes up nearly 90% of all cases. Intraoral causes consist especially of periodontitis, as well as gingivitis, dental cavities, tonsil stones, and tongue coating. Extraoral causes include gastrointestinal diseases (especially reflux), chronic liver diseases, and systemic diseases, such as diabetes mellitus (2-6). Anaerobic and gram-negative microorganisms that cause putrefaction are responsible for the etiology of extra-digestive intraoral and extraoral-nasal pathologies. These microorganisms produce volatile organic compounds (VOCs) which can be efficiently measured by the gas chromatography device called OralChroma. In intraoral and extraoral extra-digestive pathologies, the hydrogen sulfide (HS) and methylmercaptan (MM) levels are frequently found to be high in mouth breathing measurements, while the dimethylsulfide (DMS) levels are generally normal. However, in several studies, high DMS levels are also reported in extraoral pathologies (6-9). Extraoral nasal pathologies that can result in halitosis include adenoid hypertrophy, allergic rhinitis, and chronic sinusitis (4,8,9).

Concha bullosa (CB) is one of the nasal pathologies that can cause chronic sinusitis. It is defined as the pneumatization of the middle turbinate, and it constitutes one of the most common variations of the middle turbinate (10,11). It can cause mucus accumulation in the ostiomeatal complex and recurrent sinusitis by altering mucociliary activity and middle meatal drainage (10,12). When persisting mucus due to impaired drainage or increased amount is digested by bacteria, it may cause generation of HS and MM due to methionine and cysteine in its content and may appear as the culprit of foul breath (8,13).

Elmassry et al., in the review they published by compiling many articles, stated that many different VOCs can be detected in in the respiratory system colonization and infection of many different bacteria (14). In this direction, we thought that CB,

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Submitted: 17.08.2023 • **Revision Requested:** 04.10.2023 • **Last Revision Received:** 07.10.2023 • **Accepted:** 03.10.2023 • **Published Online:** 24.11.2023

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which can cause recurrent sinusitis by affecting bacterial colonization, may also be involved in the etiology of halitosis.

In this study, we aimed to compare the changes in MM levels in oral and nasal gas chromatography measurements before and after concha bullosa resection in patients who presented halitosis and displayed no etiological cause other than isolated concha bullosa.

MATERIAL AND METHODS

Patients who applied to the otorhinolaryngology outpatient clinic of the Acibadem Taksim Hospital Hospital between January 2019 and February 2022 with the complaint of halitosis were included in this study. The study was approved by the Medical Ethics Committee of Acibadem University (Date: 03.12.2021, No: 2021-23/01). All studies were conducted in accordance with the Declaration of Helsinki regarding biomedical studies involving human subjects, and written informed consent was obtained from all participants prior to the study.

Study design

Patients complaining from halitosis and presenting pathologic l VOCs detection levels in their oral and nasal breaths as measured by OralChroma were included in the study. It was confirmed that the participants had no known disease in their medical history and did not receive any medical treatment. A standard dental examination was performed by the same expert on all participants. Patients with active or severe dental cavities, gingivitis, advanced periodontitis, or oral thrush were excluded from the study. Patients with gastroesophageal reflux, liver-biliary tract diseases, and gastric-esophageal diseases, which may cause halitosis due to gastrointestinal problems as well as patients who received certain therapies due to systemic diseases that may cause halitosis, such as major head and neck surgery, chemotherapy, and radiotherapy, were also excluded from the study. Nasopharyngeal endoscopy, oropharyngeal examination, and endoscopic laryngeal examinations were performed in all patients. No septum deviation, purulent discharge, or polyp was detected during the nasal endoscopic examinations. Paranasal sinus computed tomography (PNS-CT) was performed on all patients to rule out the presence of chronic sinusitis. Patients that have normal sinus aeration but were found to have unilateral or bilateral CB,, as detected by PNS-CT were included in the study.

Setting

The patients were divided into two groups based on age, gender, and the side with concha bullosa. Concha bullosa surgery was applied to 32 patients who were determined as the surgical group, and no treatment was given to 28 patients who were determined as the control group. Since no other pathology was observed that may explain halitosis, endoscopic concha bullosa surgery was applied in the patients, both oral and nasal VOCs measurements were repeated at the postoperative third month, and the results were compared with preoperative levels. No surgical or medical treatment was applied to the patients in the control group, and the MM levels at 0 and 3 months were measured orally and nasally, before being compared.

Surgical technique

The lateral leaf of the bullous middle turbinate was excised with a 0-degree endoscope under general anesthesia. Bleeding control was done and operations were terminated. Post-operative packing was not used. Peri or post-operative antibiotics were not administered to the patients. Nose bleeding was observed in one patient in the early postoperative period and was controlled with electrocautery.

Measurement of Oral and Nasal VSCs: OralChroma

The HS, MM, and DMS levels were measured using a portable gas chromatography device (OralChroma, AbiMedical) that had previously been validated for clinical studies. This device measures VOCs individually and provides an output by graphing different VOCs in the unit of parts per billion (ppb) (5,15).

To measure the oral malodor using OralChroma, the air inside the oral cavity was sampled directly with a 1-ml syringe after keeping the mouth closed for 60 seconds. The amount of sample injected into the OralChroma was set at 0.5 ml. For sampling nasal breath, one nostril was blocked and the 1 ml syringe, without a plunger, was placed in the other nostril, with the tip of the syringe placed in the nostril cavity. The patient was then asked to breathe out through the nostril containing the syringe. After breathing for 5–10 s, the plunger was replaced and the collected 1-ml of nasal breath was immediately injected into the OralChroma device. Measurements were then taken from the other nostril in the same way. The process was completed in eight minutes. The preoperative and post-operative, oral, and nasal VSC measurements of the patients were displayed on the computer screen, with the graphs of each individual being printed out (OralChroma Data Manager, AbiMedical) (15).

Preparation for OralChroma

All participants were advised not to consume onions, garlic, and spicy foods the day before, and to avoid consumption of alcohol, coffee, and cigarettes 12 hours before their appointment. The use of chewing gum, mint, oral spray, and mouthwash was not allowed on the morning of the appointment. On the other hand, in order to avoid confusion between pathological halitosis and morning halitosis (physiological or temporary halitosis), patients were given breakfast and were allowed to brush their teeth. An information note was provided which included the instructions for oral hygiene after eating and drinking. All measurements were made between 8:30 and 11:30 in the morning (before lunch), two hours following breakfast and the oral hygiene practices. Thresholds for halitosis were accepted as 112 ppb for HS, 26 ppb for MM, and 8 ppb for DMS, which were confirmed in previous studies (15).

Statistical analysis

Statistical analyses were performed using SciPy v1.2.3. A paired t-test was used to investigate statistical significance between repeated measurements. A p-value of less than 0.05 was considered significant.

RESULTS

Population

Sixty patients (31 females, 29 males) with a mean age of 36.5±11.35 years (18-62 years) were included in the study. Concha bullosa was bilateral in 26 patients, while it was only present on the left side in 17 patients, and on the right side in another 17 patients (Table 1).

Surgical Group

Thirty-two patients (16 females, 16 males) with a mean age of 35.2±10.41 years (19-56 years) were included in the study as a surgery group. Concha bullosa was bilateral in 14 patients, while it was only present on the left side in nine patients, and on the right side in another nine patients.

Control Group

Twenty-eight patients (15 females, 13 males) with a mean age of 37.6±12.41 years (18-62 years) were included in the study as a control group. Concha bullosa was bilateral in 12 patients, while it was only present on the left side in 8 patients, and on the right side in another eight patients.

VOCs Measurements

Before and after the operation of bilateral concha bullosa and also when the surgical group and control groups were compared, the decrease in MM values was shown to be statistically significant (p:0.001).

Before and after the operation of right concha bullosa and also when the surgical group and control groups were compared, the decrease in MM values was shown to be statistically significant (p:0.002).

Table 1: Demographic informations of patients.

		Surgery	Control
Age		35.2±10.41	37.6±12.41
Gender			
	Male	16	13
	Female	16	15
	Total	32	28
Concha Bullosa			
	Bilateral	14	12
	Right	9	8
	Left	9	8
	Total	32	28

Before and after the operation of left concha bullosa and also when the surgical group and control groups were compared, the decrease in MM values was shown to be statistically significant (p:0.004).

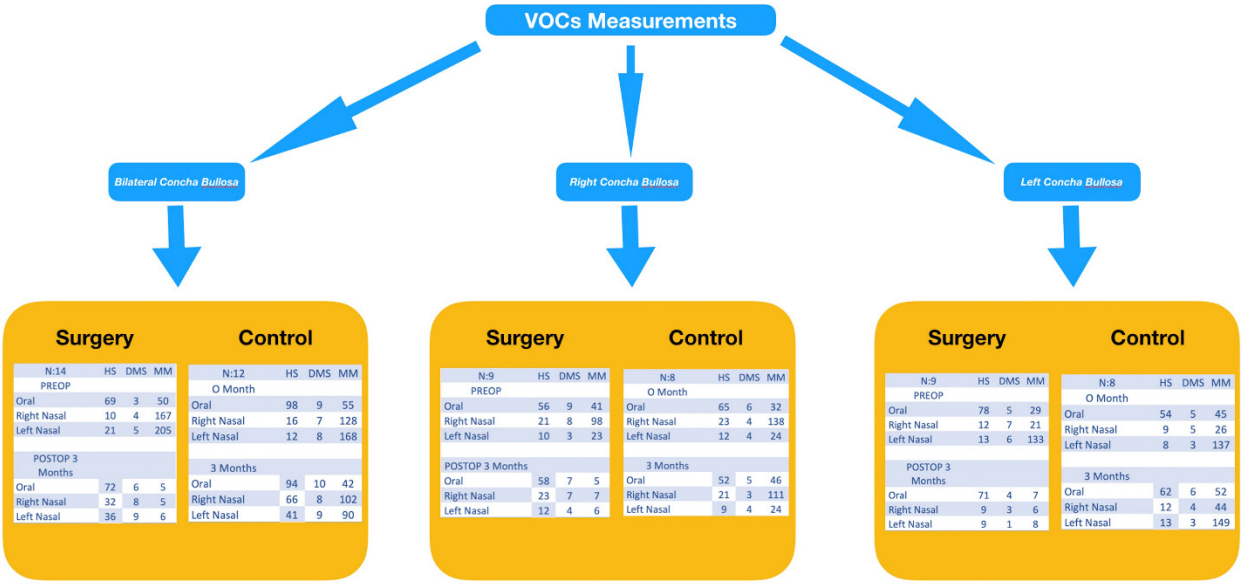
None of the groups' HS and DMS changes were statistically significant (p>0.05). All results from this procedure have been detailed in Figure 1.

DISCUSSION

Nasal and paranasal sinus anatomy is increasingly becoming better understood due to the development of nasal endoscopy and the increased use of paranasal computed tomography. Pneumatization of the middle turbinate is also detected more frequently by endoscopic nasal examinations and PNS-CT imaging. CB is seen in approximately half of all patients and constitutes the most common anatomic variation of the middle turbinate (16). Additionally, approximately half of all patients with CB has accompanying sinusitis findings (17).

It is well-known that chronic sinusitis can cause halitosis (4). However, interestingly, the patients included in our study had no findings compatible with chronic sinusitis (mucosal thickening, secretion, or inflammation) in the nasal endoscopy and PNS-CT. In addition to chronic sinusitis, halitosis has been reported in many nasal and paranasal disorders. These are mainly due to a foreign object in the nasal cavity, chronic postnasal drip, atrophic rhinitis, cleft palate-lip, adenoid hypertrophy, and allergic rhinitis. There are no studies in the literature reporting a CB-halitosis relationship without accompanying sinusitis caused by CB. Although the exact mechanism of CB-related halitosis is not known, we suggest that this might be caused by altered drainage in the middle meatus, causing mucus accumulation in this area. This, in turn, may lead to the formation of VOCs (Figure 2) as in chronic postnasal drip where anaerobic bacteria use the mucus as nutrition and metabolize the cysteine and methionine in the mucus, causing the formation of VOCs, mainly MM. In a study by Avincsal et al. on patients with allergic rhinitis, MM and DMS levels were found to be significantly higher in the study group than in the control group, and it was stated that the increase in MM levels was more prominent than in DMS levels. Similarly, in this study, the authors attributed increased MM levels to increased mucus. In our study, unlike Avincsal et al., no significant elevation was observed in the DMS levels in the preoperative measurements (8).

Secondary to nasal passage obstruction, mouth breathing has a major effect on the formation of dento-facial structures. Although enlarged adenoids are the primary cause of mouth breathing, nasal septal deviation (NSD), and inferior turbinate hypertrophy (TH) have also been implicated as other mechanical obstruction factors. Shetty et al. showed that septum deviation and CB affect the shape of the palate and may cause malocclusion. As the cause of septum deviation, CB may also be the cause of mouth breathing-induced halitosis (18).



N:14	HS	DMS	MM
PREOP			
Oral	69	3	50
Right Nasal	10	4	167
Left Nasal	21	5	205
POSTOP 3 Months			
Oral	72	6	5
Right Nasal	32	8	5
Left Nasal	36	9	6

N:12	HS	DMS	MM
O Month			
Oral	98	9	55
Right Nasal	16	7	128
Left Nasal	12	8	168
3 Months			
Oral	94	10	42
Right Nasal	66	8	102
Left Nasal	41	9	90

N:9	HS	DMS	MM
PREOP			
Oral	56	9	41
Right Nasal	21	8	98
Left Nasal	10	3	23
POSTOP 3 Months			
Oral	58	7	5
Right Nasal	23	7	7
Left Nasal	12	4	6

N:8	HS	DMS	MM
O Month			
Oral	65	6	32
Right Nasal	23	4	138
Left Nasal	12	4	24
3 Months			
Oral	52	5	46
Right Nasal	21	3	111
Left Nasal	9	4	24

N:9	HS	DMS	MM
PREOP			
Oral	78	5	29
Right Nasal	12	7	21
Left Nasal	13	6	133
POSTOP 3 Months			
Oral	71	4	7
Right Nasal	9	3	6
Left Nasal	9	1	8

N:8	HS	DMS	MM
O Month			
Oral	54	5	45
Right Nasal	9	5	26
Left Nasal	8	3	137
3 Months			
Oral	62	6	52
Right Nasal	12	4	44
Left Nasal	13	3	149

Figure 1: Figure of VOCs levels in Bilateral Concha Bullosa, Right Concha Bullosa and Left Concha Bullosa

HS: Hydrogen sulfide, DMS: Dimethylsulfide, MM: Methylmercaptan

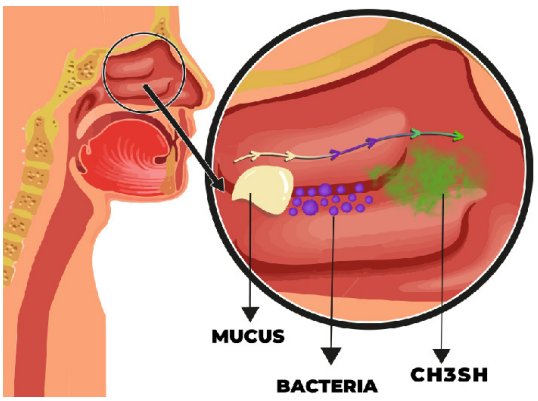


Figure 2: Increased or impaired drainage of mucus causes the formation of volatile sulfur compounds, especially methylmercaptan (CH3SH), as a result of bacterial digestion, and these compounds are excreted from the mouth and nose with respiratory air.

Also, if the CB is located opposite the deviated side of the septum, it balances the airflow between the two nostrils. However, the surface area-to-volume ratio and total nasal resistance in this group was significantly higher and the nasal volume was significantly decreased than the patients who do not have CB. This may have affected the nasal microbiota and caused the production of VOCs (19).

In this study, we not only made oral measurements, but also made nasal measurements and observed that in the extra-digestive system, the airway can reveal the odor in all directions during expiration. Accordingly, we found high MM levels on the same side of a concha bullosa formation. After the drainage was corrected in this area, mucus circulation improved, post-operative MM levels decreased, and finally, halitosis was resolved. The limitation of the study was that only patients with halitosis and concha bullosa formations were included in the study. However, in our daily clinical practice, we encounter that many patients with concha bullosa have normal oral and nasal VOCs measurements. Takeshita et al. showed that oral MM HS levels are high in individuals with a high burden of Prevotella, Veillonella, Atopobium, Megasphaera, and Selenomonas in their oral microbiota (20). Whether CB causes bad breath or not may be related to the colonization of these bacteria because not every CB causes bad breath. Simultaneous microbiological examination will provide clearer information about the mechanism of causing halitosis. This research shows that CB may cause halitosis if the etiology cannot be determined in patients with halitosis and MM in the foreground.

Therefore, it should be kept in mind that CB may cause halitosis in cases with prominent MM increase where halitosis etiology cannot be determined.

Main Points

1. Ninety percent of bad breath originates from the oral cavity.
2. The causes of halitosis originating from the nose can be shown as deviation, turbinate hypertrophy, allergy, nasal polyps, and chronic sinusitis.
3. Concha bullosa may cause bad breath by disrupting the drainage in the middle meatus.
4. Patients with concha bullosa without any obvious nasal pathology were included in our study. These patients had high preoperative methylmercaptan levels, and methylmercaptan levels decreased significantly as a result of opening the concha bullosa. Although we cannot provide a clear explanation for the mechanism, we believe that mucus drainage and bacterial putrification are effective in this.

CONCLUSION

The cause of an increase in the clinical measurements of the extra-digestive system may not be revealed sufficiently with an evaluation of only the tongue and teeth. Since it has a connection with the airway, the nasal cavity must also be evaluated, because medical conditions in this area could be the underlying cause of halitosis that reveals itself during expiration.

Acknowledgements: We would like to thank our technician Necmiye Duzgun for meticulously performing oral and nasal measurements with Oral Chroma.

Ethics Committee Approval: This study was approved by the Medical Ethics Committee of Acibadem University (Date: 03.12.2021, No: 2021-23/01).

Informed Consent: Written informed consent was obtained.

Peer Review: Externally peer-reviewed.

Author Contributions: Conception/Design of Study- A.A.; Data Acquisition- E.Y.; Data Analysis/Interpretation- M.C.K.; Drafting Manuscript- E.Y., M.C.K.; Critical Revision of Manuscript- A.A.; Final Approval and Accountability- A.A., M.C.K.; Material or Technical Support- A.A., E.Y.; Supervision- A.A., M.C.K.

Conflict of Interest: The authors have no conflict of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

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