The relationship between white tongue and gastroesophageal reflux disease

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Research Article

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Abstract

Background

Signs of gastroesophageal reflux disease (GERD) are limited, therefore, follow up of treatment are mainly based on patients' symptoms. The aims of study were: 1) to compare the prevalence of white tongue (WT) between individuals with GERD and control group, 2) to evaluate the correlation between WT extension and severity of symptoms in GERD.

Materials and methods

This case-control study consisted of 100 consecutive individuals with GERD who were referred to the gastroenterology clinic of a referral hospital during 2019-2020. The diagnosis of GERD was made by a gastroenterologist if heart burn or regurgitation existed. The same number of healthy accompanies of patients without GERD participated as the control group. A single examiner defined WT if whitish-gray discoloration of tongue surface existed in two separate sessions [$\text{Kappa} = 0.93$; $p < 0.01$]. WT extension was estimated based on the approximate white discoloration of the tongue surface.

Results

All participants with GERD showed white tongue in the first observation and 98% in the second observation, while only 5% of the individuals in the control group revealed WT in both observations ($p < 0.001$). There was a positive correlation between the WT extension and GERD symptom severity ($r: 0.44$; $p < 0.001$).

Conclusion

It seems that WT might be a reliable sign of GERD. Considering the association between GERD symptoms severity and the extent of WT in this observation, further studies may assess the utility of WT extension as a reasonable objective in monitoring treatment response.

Introduction

Gastroesophageal Reflux Disease (GERD) is a common gastrointestinal disorder that adversely affects the patients' quality of life (1–3). Considering wide use of over-the-counter medications and diagnostic procedures, it imposes a huge economic burden on the healthcare system (4). Esophageal ulcers, peptic stricture, Barrett's esophagus, and adenocarcinoma are the most important complications (5). The pathophysiology includes the changes in the lower esophageal sphincter relaxation and pressure, esophageal motility disorder, and even damage to the sensory cells of the tongue (6). GERD diagnosis is achieved based on the typical symptoms of heartburn and regurgitation, and 24-hour pH monitoring in

individuals with extraesophageal (atypical) symptoms. Although subxyphoid tenderness is considered as the most commonly used sign attributed to GERD, this sign has great overlap with other conditions including peptic ulcer disease and upper gastrointestinal malignancies. It seems that the signs of disease are limited, therefore the monitoring of treatment efficacy are mainly based on patients' self-expressed symptoms (7).

The healthy tongue color is pink which is induced by small nodules (papillae) that are on the surface of the tongue and have a rough texture. Following lodgment of food debris, sluffed epithelial cells, and bacteria between inflamed tongue papilla, the whitish discoloration of tongue surface occurs. The reflux of gastric secretions into the oral cavity could affect the tongue epithelium causing white tongue (WT) or coated tongue appearance. Notably, a wide range of conditions could affect the oral cavity environment and cause WT (8). Oral cavity infections, inflammations and cancers, dry mouth (xerostomia), poor oral hygiene, vitamin deficiencies, pregnancy, irritant foods, specific medications, alcohol consumption, smoking and chewing tobacco are the common situations that damage the epithelium and induce a coated tongue (9–14).

We decided to assess if WT might be a reliable sign for the diagnosis of GERD in a selected cohort of participants who diagnosed by typical heart burn and regurgitation. The aims of this study were: 1) to compare the prevalence of WT between individuals with GERD and healthy controls without GERD, 2) to evaluate the correlation between the extent of WT and the severity of the symptoms in individuals with GERD.

Patients And Methods

Study design

This is a case-control observational study which was conducted in a tertiary medical center from September 2019 until September 2020. The study was performed based on the Declaration of Helsinki and the study protocol was approved by the Ethics Committee of the Research Deputy, Tehran University of Medical Sciences (registration number: IR.TUMS.SINAHOSPITAL.REC.1399.041).

Study Participants

Hundred consecutive individuals with GERD who were referred to the gastroenterology clinic of Sina Hospital, a referral hospital affiliated with Tehran university of Medical Sciences composed the case group. Gastroenterologist diagnosed GERD based on symptoms including typical heart burn or regurgitation. The same number of the healthy accompanies of patients without GERD symptoms comprised the control group. Biostatistician matched each subject in control group with the case group (1:1) regarding age and sex. An expert dentist examined the oral cavity for the determination of conditions that might cause WT based on the previous reports (9–14). The individuals with the following criteria (n=64) were excluded from the study: existence of xerostomia (such as breathing and sleeping with the mouth open, Sjögren's disease, body dehydration, and fever), self-report of poor oral hygiene

(inappropriate brushing, not flossing, not cleaning the tongue), self-report of irritation of tongue (by sharp edges of teeth, dentures and prostheses or orthodontic brackets, piercings, and irritations caused by foods), vitamin B12 and iron deficiencies, excessive alcohol consumption, smoking, chewing tobacco, current use of antibiotics and steroids, systemic co-morbidities including cancer chemotherapy, diabetes, heart failure, chronic kidney disease, chronic obstructive pulmonary disease, and cirrhosis, current oral diseases (including oral thrush, syphilis, glossitis, lichen planus, cancer), and pregnancy.

Study Measures

A reliable questionnaire was applied to evaluate the severity of symptoms in GERD (15). Individuals with GERD were classified in three groups of mild, moderate, and severe symptoms. The mild group consisted of individuals that do not feel symptoms if they do not think about them. The moderate group included those who feel the symptoms even if they do not think about them. The severe group feels symptoms which interfere with their quality of life. A single gastroenterologist assessed presence of the WT for all participants which were defined as white discoloration of the tongue surface in adherence to the study of Lundgren et al. (16). The WT diagnosis was confirmed a week after by the same assessor. The extension of WT was measured based on the approximate white discoloration of the tongue surface. It was graded as grade 0 (if no tongue coating present), grade 1 (if less than 33% tongue coating present), grade 2 (if tongue coating was between 33-66%) and grade 3 (if tongue coating was more than 66%) according to the grading system used by the previous study (16).

Statistical Analysis

Statistical analysis was performed with IBM SPSS v19 (IBM, Armonk, NY, USA). Kolmogorov-Smirnov test was applied to assess the distribution of quantitative data. Mann-Whitney U test was utilized to assess differences among quantitative variables among groups. Chi square was used to compare qualitative variables between individuals with GERD and healthy controls without GERD. Intra-observer agreement between two separate observations of WT was almost perfect [Kappa = 0.93 ($\pm$ 0.03); $p < 0.01$]. The correlation between GERD symptoms severity and the extent of WT was measured via Spearman correlation coefficient.

Results

After excluding individuals with conditions that cause WT, one hundred participants with GERD (45 males and 55 females) and one hundred individuals without GERD (42 males and 58 females) accomplished the study. Participants' characteristics regarding age, gender, and anthropometric measures are reported in Table 1. There were no statistically differences between the groups in terms of age (control: 43.72 ± 4.87 , GERD: 41.61 ± 10.28 ; $p = 0.07$), weight (control: 82.82 ± 5.71 , GERD: 81.65 ± 11.41 ; $p = 0.36$), and body mass index (control: 30.78 ± 2.11 , GERD: 30.36 ± 3.53 ; $p = 0.33$). Symptoms of GERD (including heartburn, regurgitation, globus sensation, chest pain, cough, laryngitis, and sleep apnea), endoscopic findings and presence of WT are reported in Table 1. All participants in the GERD group showed white

tongue (100%) in the first observation and 98% in the second observation, while only 5% of the patients in the control group revealed WT in both observations ($p < 0.001$).

Table 1

The characteristics of the study participants regarding age, anthropometric measures, presence of white tongue, gastroesophageal reflux symptoms and endoscopic findings

Variables	Control (n = 100)	Gastroesophageal Reflux (n=100)	p
Age (years)	43.72 (± 4.87)	41.61(± 10.28)	0.07
Male/Female (n, %)	42 (42.0)/58 (58.0)	45 (45.0)/55 (55.0)	0.56
Weight (Kilogram)	82.82 (± 5.71)	81.65 (± 11.41)	0.36
Body mass index (Kilogram/meter ²)	30.78 (± 2.11)	30.36 (± 3.53)	0.33
White tongue in first observation (n, %)	5 (5.0)	100 (100)	< 0.001
White tongue in second observation (n, %)	5 (5.0)	98 (98)	< 0.001
Heartburn (n, %)	-	95 (95.0)	NA
Regurgitation (n, %)	-	40 (40.0)	NA
Globus sensation (n, %)	-	28 (28.0)	NA
Chest pain (n, %)	-	6 (6.0)	NA
Cough (n, %)	-	15 (15.0)	NA
Sleep apnea (n, %)	-	2 (2.0)	NA
Laryngitis (n, %)	-	3 (3.0)	NA
Endoscopic findings			
Esophagitis (n, %)	-		
Non-erosive	-	80 (80.0)	NA
Loss angles grade 1	-	17 (17.0)	NA
Loss angles grade 2	-	3 (3.0)	NA
Hiatal Hernia (n, %)	-		
None	-	54 (54.0)	NA
Small size	-	40 (40.0)	NA
Medium size	-	4 (4.0)	NA
Large size	-	2 (2.0)	NA
Data presented as mean (± standard deviation), unless otherwise specified; NA: not applicable			

Variables	Control (n = 100)	Gastroesophageal Reflux (n=100)	p
Inlet Patch	-	12 (12.0)	NA
Gastric outlet obstruction	-	2 (2.0)	NA
Data presented as mean ($\pm$ standard deviation), unless otherwise specified; NA: not applicable			

The extent of WT among different severities of GERD symptoms is demonstrated in Table 2. A positive correlation was detected between the WT extension and GERD symptom severity (Spearman correlation coefficient = 0.44; $p < 0.001$).

Table 2
The correlation between white tongue extent and gastroesophageal reflux disease symptoms severity

		Gastroesophageal symptom severity			
		Mild (n=52)	Moderate (n=28)	Severe (n=20)	Total (n=100)
White tounge extent	< 33% (n=54)	40 (40.0%)	8 (8.0%)	6 (6.0%)	54 (54.0%)
	33-66% (n=26)	6 (6.0%)	14 (14.0%)	6 (6.0%)	26 (26.0%)
	> 66% (n=20)	6 (6.0%)	6 (6.0%)	8 (8.0%)	20 (20.0%)
Correlation coefficient: 0.44; P value < 0.001					

Discussion

Considering the limitations in the signs of GERD, we aimed to assess WT, as a physical finding can discriminate individuals with GERD from healthy participants. Wang et al. expressed the value of tongue inspection as an important diagnostic method in medicine. They suggested that examination of the tongue with regard to color, spirit, shape, coating and moisture by a specialist would determine the patient's health status (17). We assumed that the gastric reflux into the oral cavity might cause damage to tongue epithelium and thus induce WT. To the best of our knowledge, this is the first study that evaluated the association between GERD and WT. We found that the prevalence of WT is considerably greater in individuals with GERD compared to those of control group. Furthermore, we observed a positive correlation between the severity of WT and severity of the symptoms in individuals with GERD.

The result of our study is in accordance with that of a case-control observation conducted by Wu et al. who assessed the correlation between GERD and tongue characteristics. Their results showed the greater amount of saliva and thicker tongue fur (especially in the spleen and stomach area) in individuals with GERD compared to controls. The authors concluded that inspection of tongue could be a non-invasive method for GERD diagnosis (18). Considering the dysfunction of lower esophageal sphincter in GERD, Avijgan et al. argued that tongue contact with gastric secretions can have different effects. The aim of their investigation was to discover the relationship between the tongue manifestations in Chinese traditional medicine and GERD. They found that the most characteristics of the tongue except for the color and structure did not differ between participants with GERD (n=50) and controls (19). Meanwhile, Wang et al. studied changes in tongue manifestations and clinical outcomes of gastric ulcer disease. The tongue fur was significantly thinner with discoloration to white, while sublingual blood vessels improved with blood clotting and stagnation after *Helicobacter pylori* wound healing and eradication. The study proposed that tongue observation could potentially be used as a complementary non-invasive diagnostic method and as an indicator for the clinical outcome of patients with this disease (20).

A major limitation of the current pilot study is the small sample size. At the time of study designing, we had not found any data for estimation of WT prevalence in GERD patients. Therefore, it was impossible to precisely calculate the sample size. In addition, this survey was conducted in those GERD patients who were diagnosed based on typical GERD symptoms; therefore, the results could not be generalized to all GERD subjects. We emphasize that clinical based definition is not enough for correlation studies in the area of GERD. The lack of data regarding the 24 h PH monitoring in GERD individuals is the other limitation of study. Considering the design of this study, it is not possible to determine if WT would diminish after appropriate GERD treatment. Therefore, longitudinal study with a greater sample size in a cohort of GERD patients (including atypical symptoms) is suggested to identify if the severity of WT can be used in monitoring the response to treatment. Another limitation of this study was the method used for determination of WT extension. We reported WT extension according to the clinician's inspection. It is suggested to take standard photographs from the top surface of the tongue and measure the extent of white discoloration via an appropriate software.

In conclusion, it seems that WT can be considered as sign of GERD. Considering the association between the severity of the symptoms in participants with GERD and the severity of WT in this observation, we recommend evaluating the severity of WT as an objective assessment for monitoring the response to treatment in individuals with GERD.

Declarations

Conflict of Interest:

The authors declare that no conflict of interest exists.

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