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# Assessment of Dysphagia as a Risk Factor of Chronic Cough

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## Abstract

**Background:** The aim of the study was to determine the prevalence of dysphagia in patients with chronic cough and its relationship with the long-term persistence of these symptoms. **Methods:** Thirty consecutive patients. All patients underwent physical examination, ENT assessment, videolaryngoscopy, functional phoniatic assessment at rest and speech, Water-Swallow Test, and Fiberoptic Endoscopic Evaluation of Swallowing disorders with Reflux Finding Score. Reflux Symptom Index questionnaire was performed. The study was approved by the local Ethics Committee Review Board (KB/39/A/2016). **Results:** The results of the RFS and the RSI questionnaire showed the risk of reflux in participating patients. The patients presented episodes of spillage, double swallows, penetration, aspiration and residue of food at the hypopharynx. The results of functional assessment correlated with the Water-Swallow Test. The correlation between Fiberoptic Endoscopic Evaluation of Swallowing disorders and Water-Swallow Test results was found for aspiration risk, spillage, and retention of saliva. **Conclusion:** The results of the study showed prevalence of dysphagia in most patients with chronic cough. It seems that phoniatic assessment in those cases should be expanded and the following tests should be performed: assessment of the laryngeal elevation, Water-Swallow Test, and Fiberoptic Endoscopic Evaluation of Swallowing disorders.

**Keywords:** dysphagia, chronic cough, phoniatic, water swallowing test, aspiration

## 1. Introduction

Chronic cough is commonly reported symptoms in clinical practice. However, there is no globally accepted definition. Chronic, disruptive, lasting more than eight weeks cough is a difficult diagnostic and therapeutic problem [1]. The other used in researches definition of chronic cough is a cough lasting  $\geq 3$  months [2] or “daily coughing for at least 3 months duration during preceding 2 years [3]. Recently, replacing term chronic term by cough hypersensitivity syndrome has been proposed to highlight different phenotypes of this condition [4]. We can distinguish also idiopathic chronic cough and refractory chronic cough [5].

In approximation, it can affect 10–40% of general population [1, 3, 6].

The prevalence depend on sex, age and comorbidities. Recent observational study indicated that females, older adults, patients suffering from gastro-esophageal reflux disease, asthma, chronic obstructive pulmonary disease are at risk of chronic cough [3, 7]. Among additional risk factors are smoking [7] and drugs (e.g. angiotensin -converting enzyme inhibitors) [8].

People suffering from it require a multidisciplinary diagnostic panel like allergology tests, gastrological, pulmonary, otolaryngology and phoniatic counseling [1]. Despite enhanced diagnostics - the final diagnosis is difficult to be established, and the introduction of effective therapy sometimes impossible, which significantly reduces the quality of life in those patients [1, 9–11]. In practice, diagnosis of chronic cough raises difficulties cause cough can be symptom of disease from the one side, but from the other also consequence. Therefore carefully taken history provides information about potential causes. Clinical interview should aimed on exclusion malignancy, ongoing infection, body inhalation or using angiotensin converting enzyme inhibitors (ACE). Further question should focused on chronic pulmonary diseases, GERD, allergy [12]. The medical history should be deepen by different advanced methods like: chest CT or radiography, CT of sinusitis, spirometry, airway hypersensitivity test, allergic test, bronchoscopy, endoscopic examination of nose and paranasal sinuses, videolaryngostroboscopy, FEES, FVS, pH-metry, high resolution manometry, gastroscopy and functional assessment [5, 8]. Until recently, mainly pharmacological treatment was delivered. Results were promising although not free from side effects. The most often proposed pharmacological therapies include: proton pump inhibitors and prokinetics agents, histamine H1 antagonists, inhaled corticosteroids and nasal steroids. In case of lack of therapeutic effect gabapentin, pregabalin are recommended. Other drugs like morphine, tramadol, codeine and dextromethorphan, amitriptyline are still controversial [12, 13]. Chronic cough treatment is still not well recognized, so the new pharmacological substance like Gefapixant are under investigation [14]. Recently physiotherapist and speech language therapist proposed several non-pharmacological treatment concentrated on breathing exercises and counseling. Following non-pharmacological components were indicated: education, psycho-educational counseling, vocal/laryngeal hygiene and hydration, cough control/suppression techniques [5].

Despite cough is a natural defense mechanism of the airway, a little is known about chronic cough long term implications. Our clinical experience shows that the from the one side increased neck muscle tension leads to lowering the elevation of the larynx and impedes swallowing thus favoring retention of food, and food penetration or aspiration into the respiratory tract. But from the other side, delay opening upper esophageal sphincter. This in turn may result in further worsening of the symptoms causing persistent cough. The association of GERD and swallowing problems implicate the risk of microaspiration into the lungs what can trigger persistent cough. The little is known about prevalence of microaspiration as a consequence of chronic reflux disease [8].

To our best knowledge, there are no published studies referring to dysphagia in patients with chronic cough. Clinical experience shows that the increased neck muscle tension leads to lowering the elevation of the larynx and impedes swallowing thus favoring retention of food, and food penetration or aspiration into the respiratory tract. This in turn may result in further worsening of the symptoms causing persistent cough.

## **2. Aim of study**

The aim of the study was to determine the prevalence of dysphagia in patients with chronic cough and its relationship with the long-term persistence of these symptoms.

### 3. Materials and methods

#### 3.1 Inclusion and exclusion criteria

Thirty consecutive patients were enrolled in this study. All of them underwent phoniatric counseling due to chronic cough. Inclusion criteria were as follow: cough lasting more than 8 weeks, the lack of response to standard antiallergic, antireflux and antiasthmatic therapy. The patients with previously diagnosed dysphagia, with stroke or trauma to the head and neck were excluded from the study. Medications that may cause dysphagia were also a part of the exclusion criteria.

#### 3.2 Methods

All patients underwent physical examination, Ear, Nose and Throat (ENT) assessment with a detailed evaluation of the cranial nerves, in particular V, VII, IX, X, and XII cranial nerve, and Fiberoptic Endoscopic Evaluation of Swallowing disorders (FEES). Pulmonary counseling and allergy tests were also performed in each participating patient.

All patients completed a Reflux Symptom Index questionnaire (RSI). RSI consists of nine questions regarding extraesophageal symptoms of gastroesophageal reflux disease, assessed on a scale of 0–5. A score of over 13 points is interpreted as abnormal and indicates the need for further investigation e.g. gastroscopy, esophageal impedance test [15].

Phoniatric assessment included careful visual inspection of the oral cavity, pharynx and the larynx, videolaryngoscopic evaluation (VLS) and functional assessment of the larynx. The changes noticed in the larynx were assessed using the Reflux Finding Score (RFS) that rates objectively the laryngeal reflux changes. The scale ranges from 0 to 22 points where the result of 7 and more points indicates laryngopharyngeal reflux [16].

On physical examination, particular attention was drawn to: pharyngeal reflexes, strength, range and coordination of the oral cavity and pharyngeal muscles, and elevation of the larynx during swallows.

In the functional assessment the following was evaluated:

- posture - normal, increased or decreased lumbar and cervical lordosis
- breathing pattern - upper chest, chest-abdominal, and abdominal breathing
- tension of the sternocleidomastoid muscle (SCM), pharyngeal walls and sub-mandibular area muscles - on a scale of 0-II<sup>o</sup> where 0<sup>o</sup> means normal tension, I<sup>o</sup> means medium increased, II<sup>o</sup> means significant tension
- thyrohyoid and the cricothyroid space - normal or reduced.

For the screening assessment of dysphagia the water-swallow test (WST) was used in following steps (liquid volume): 5, 10, 20, and 90 ml of non-carbonated water. After each step the presence of indirect signs of penetration/aspiration of the liquid into the larynx, i.e. coughing, change in voice quality, throat clearing, portioning or test termination [17].

Fiberoptic Endoscopic Examination of Swallowing (FEES) was used for a static and dynamic evaluation of the upper airways and upper digestive tract structures with the anatomy and physiology of the pharynx and larynx during swallows. FEES also gives opportunity to evaluate pharyngeal walls movements during phonation

(squeeze maneuver) and swallowing of different food consistency. Food consistency was gradually changed from liquid (non-carbonated water), puree (water thickened to the consistency of pudding), and solid food (rucks). In FEES the efficiency of swallowing and penetration/aspiration were assessed using Penetration-Aspiration Scale (PAS). According to Rosenbeck's criteria the scale ranges from 1 to 8, where 1 means no problem, 2–5 means different degree of penetration with or without cough, 6–8 means different degree of aspiration with or without the cough [18–21].

### 3.3 Ethical statements

The study was approved by the local Ethics Committee Review Board (KB/39/A/2016). All subjects gave their written informed consent to participation in the study.

### 3.4 Statistical analysis

Statistical analysis was performed using Statistica software (StatSoft, Inc., data analysis software system, version 10). The data were tested for normality, parametric and nonparametric criteria. To analyze the data, the Pearson test was used, and  $p < .05$  was considered statistically significant.

## 4. Results

### 4.1 Patients characteristics

The study group included 25 women and 5 men, mean age 55.83 years (SD 15.17), reporting cough for the last 2 to 360 months (mean 48 months  $\pm$  100.61) (**Table 1**).

The results of the RFS and the RSI questionnaire showed the risk of reflux in participating patients, RFS = 18.96 (SD 7.02) and RSI = 10.82 (SD 2.73) (**Table 1**). A statistically significant correlation was found between the age of patients and the result of RFS ( $p = .03$ ).

### 4.2 Clinical assessment of dysphagia

The functional assessment at rest revealed increased submandibular and the pharyngeal walls tension in 19 patients, and SCM increased tension on the right

Analyzed parameter	Mean ( $\pm$ SD)
Females:Males	25:5
Age [years]	55,83 ( $\pm$ 15,17)
Body weight [kg]	73,86 ( $\pm$ 14,62)
Height [m]	164,50 ( $\pm$ 8,89)
Body mass index (BMI) [ $\text{kg}/\text{m}^2$ ]	26,90 ( $\pm$ 5,05)
Duration of cough [months]	48,00 ( $\pm$ 100,61)
RSI [points]	18,96 ( $\pm$ 7,02)
RFS [pints]	10,82 ( $\pm$ 2,73)

*RSI (Reflux Symptom Index); RFS (Reflux Finding Score).*

**Table 1.**  
*Characteristics of the study group.*

and left side in 23 and 24 patients, respectively. The reduced thyrohyoid and cricothyroid space was observed in 14 and 16 patients, respectively. The upper chest breathing pattern was observed in 19 subjects. In most of the patients, the increased cervical lordosis (22 patients) and decreased lumbar lordosis (23 patients) was observed. Disorders observed at speech were comparable or more intense to those found at rest (**Table 2**).

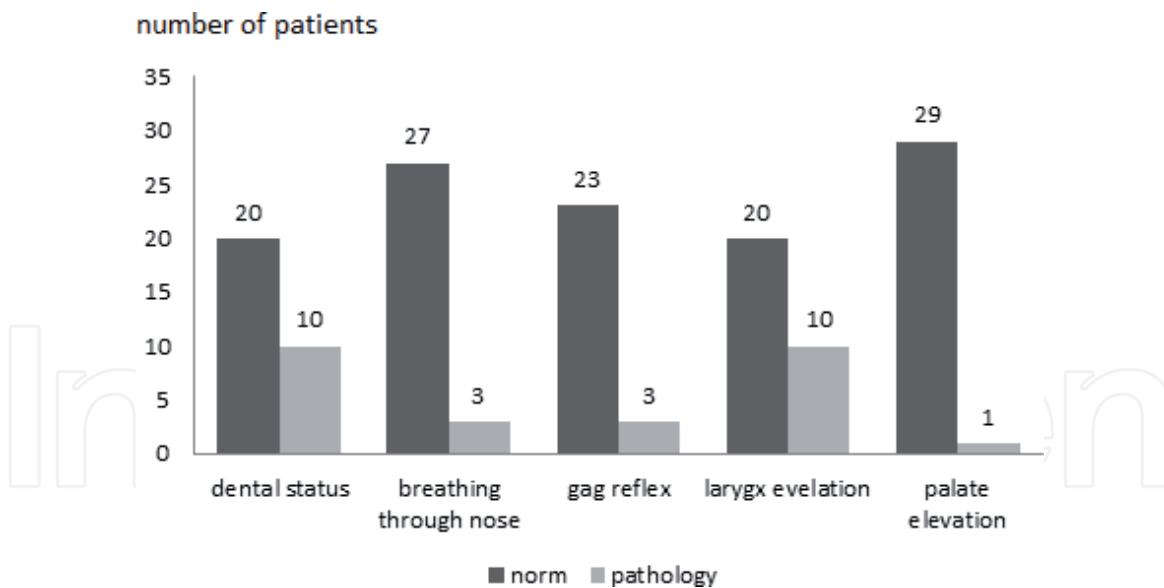
On physical examination the following was found: normal pharyngeal reflexes in 23 patients, normal soft palate activity during swallows in 29 patients, and impaired elevation of the larynx in 10 (**Figure 1**).

In case of water swallowing test (WST) results, the negative (no risk of aspiration) result was found in 28 patients (93.33%) for 5 ml amount of liquid, in 24 (80.00%) for 10 ml, in 21 (70.00%) for 20 ml, and in 15 (50.00%) for 90 ml (**Figure 2**). The remaining patients demonstrated positive WST result, which is associated with the risk of aspiration and requires verification by the objective diagnostic methods like FEES and/or videofluoroscopy [17].

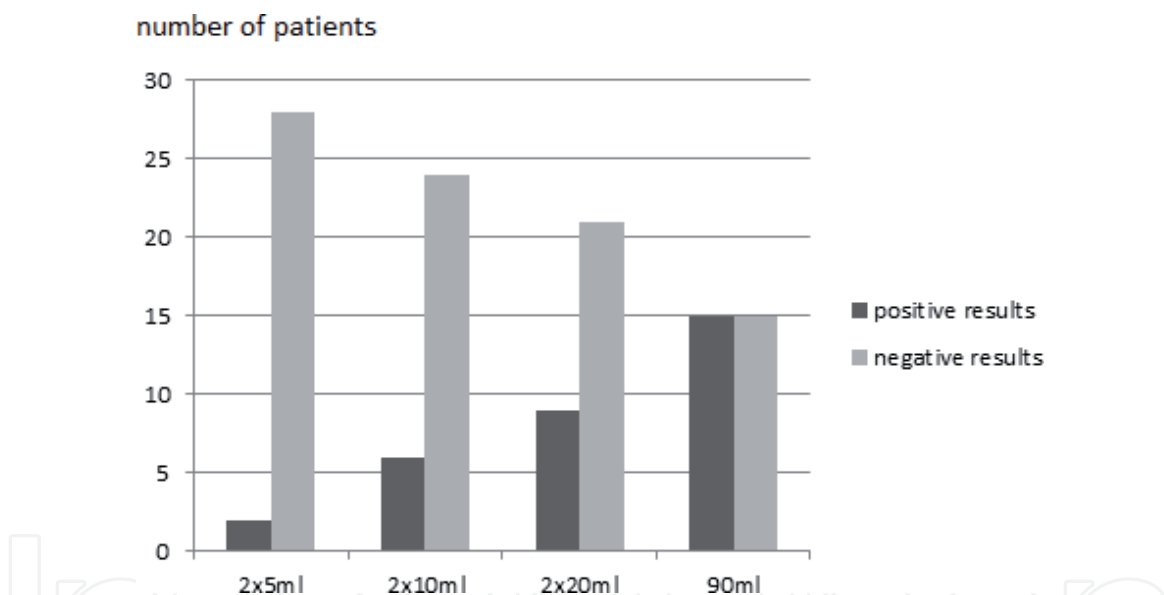
Analyzed parameter		at rest number of patients (%)	at speech number of patients (%)
Submandibular tension	normal tension	10 (33.33%)	1 (3.33%)
	increased I <sup>0</sup>	17 (56.67%)	12 (40.00%)
	increased II <sup>0</sup>	2 (6.67%)	16 (53.33%)
Pharyngeal walls tension	normal tension	10 (33.33%)	5 (16.67%)
	increased I <sup>0</sup>	17 (56.67%)	9 (30.00%)
	increased II <sup>0</sup>	2 (6.67%)	15 (50.00%)
SCM tension right side	normal tension	6 (20.00%)	4 (13.33%)
	increased I <sup>0</sup>	19 (63.33%)	9 (30.00%)
	increased II <sup>0</sup>	4 (13.33%)	16 (53.33%)
SCM tension left side	normal tension	5 (6.67%)	2 (6.67%)
	increased I <sup>0</sup>	13 (43.33%)	10 (33.33%)
	increased II <sup>0</sup>	11 (36.67%)	17 (56.67%)
Thyrohyoid space	normal	15 (46.66%)	10 (33.33%)
	reduced	14 (46.67%)	19 (63.33%)
Cricothyroid distance	normal	13 (43.33%)	7 (23.33%)
	reduced	16 (53.33%)	22 (73.33%)
Breathing pattern	upper chest	10 (33.33%)	9 (30.00%)
	chest-abdominal	19 (63.33%)	20 (66.67%)
Cervical lordosis	decreased	3 (10.00%)	3 (10.00%)
	normal	4 (13.33%)	4 (13.33%)
	increased	22 (73.33%)	22 (73.33%)
Lumbar lordosis	decreased	23 (76.67%)	23 (76.67%)
	normal	4 (13.33%)	4 (13.33%)
	increased	2 (6.67%)	2 (6.67%)

SCM (Sternocleidomastoid muscle).

**Table 2.**  
 The results of functional examination.



**Figure 1.**  
Physical examination results.



**Figure 2.**  
Water-swallow test (WST) results. Positive result means risk of aspiration, negative result means no risk of aspiration.

### 4.3 Statistical correlations

Statistically significant correlation between some of the results of functional assessment at rest and speech and the WST results were found.

In case of the functional assessment at rest, a positive 5 ml WST result was found only in patients with increased submandibular and pharyngeal walls muscle tension (both  $p = .03$ ), and for 10 ml WST in patients with increased SCM tension on the left side ( $p = .03$ ) and for 10 and 20 ml WST in subjects with upper chest breathing pattern ( $p = .04$  and  $p = .01$ , respectively).

In case of functional assessment at speech, the upper chest breathing pattern correlated with abnormal WST results. All patients with upper chest breathing pattern demonstrated positive WST result for 10 and 20 ml liquid test ( $p = .06$  and  $p = .01$ , respectively).

On physical examination the following was found: normal pharyngeal reflexes in 23 patients, normal soft palate activity during swallows in 29 patients, and impaired elevation of the larynx in 10 (**Figure 1**). However, only the impaired elevation of the larynx was correlated with the abnormal 5 ml WST results ( $p = .03$ ).

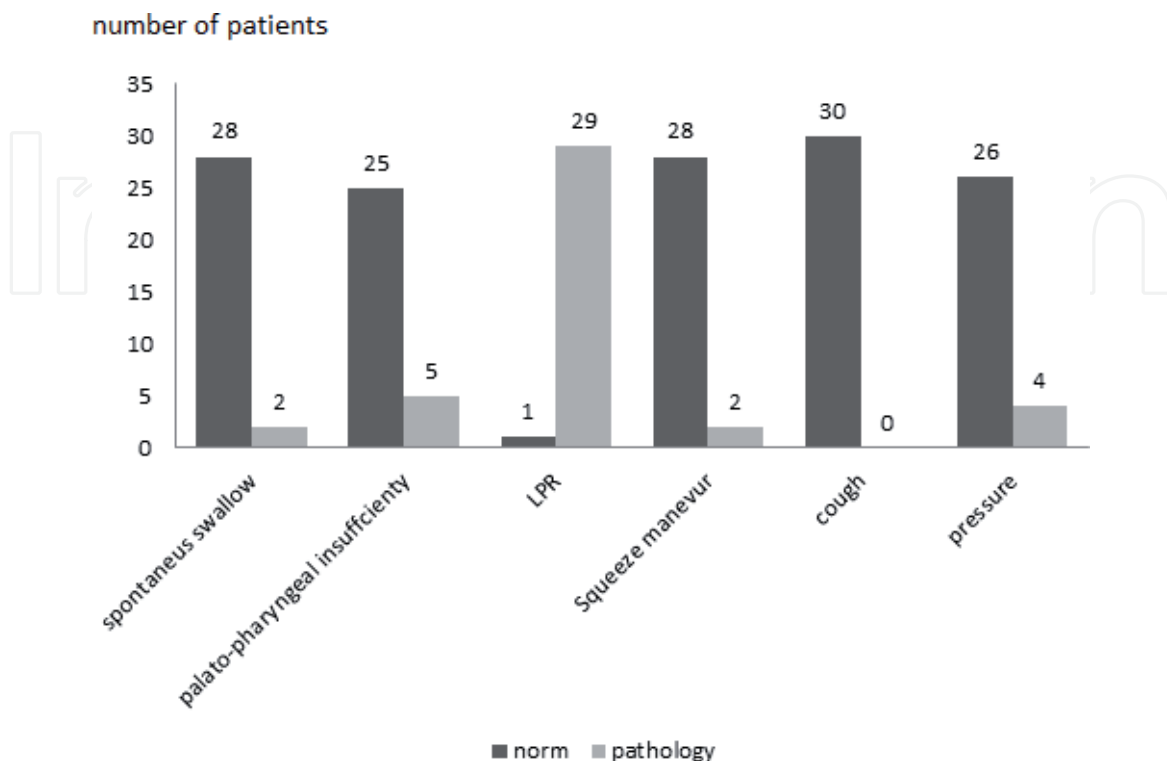
In case of WST results, the negative (no risk of aspiration) result was found in 28 patients (93.33%) for 5 ml amount of liquid, in 24 (80.00%) for 10 ml, in 21 (70.00%) for 20 ml, and in 15 (50.00%) for 90 ml (**Figure 2**). The remaining patients demonstrated positive WST result, which is associated with the risk of aspiration and requires verification by the objective diagnostic methods like FEES and/or videofluoroscopy

#### 4.4 Other results

In FEES examination, in 5 patients (16.67%) small palato-pharyngeal insufficiency was found, and in almost all patients (29 subjects, 96.67%) enlarged lingual tonsil and laryngopharyngeal reflux symptoms. Laryngeal closure and squeeze maneuver (pharyngeal wall motions during phonation) were normal in most of the patients: vocal folds closure during cough (30 subjects, 100%), Valsalva maneuver (26 subjects, 86.67%), squeeze maneuver (28 subjects, 93.33%). Two patients (6.67%) did not show any of the spontaneous swallows. Retention of saliva at the level of the hypopharynx and larynx was found in 27 patients (90.00%).

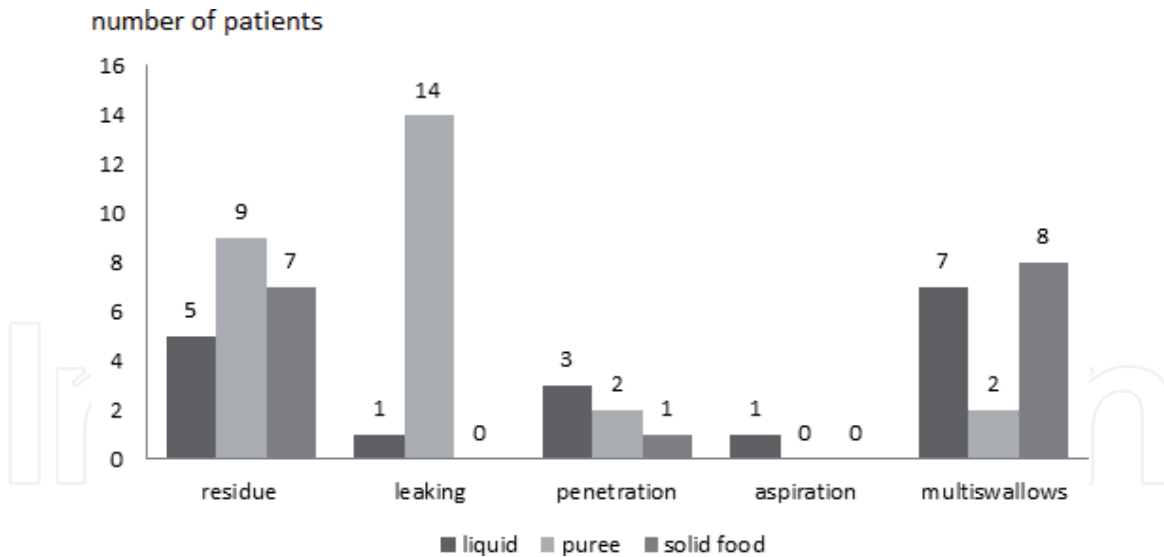
The FEES evaluation of different food consistencies revealed (**Figures 3–6**):

- residue (bolus left in the pharynx after swallow) in 5 patients (16.67%) for liquid, 9 (30.00%) for puree, and in 7 (27.33%) for solid food
- spillage (bolus falls over the base of the tongue before the swallow begins) in 1 patient (3.33%) for liquid, and in 14 subjects (46.67%) for puree
- multiswallows in 7 patients (23.33%) for liquid, 2 (6.67%) for puree, and in 8 (26.67%) for solid food



**Figure 3.** Fiberoptic endoscopic examination of swallowing (FEES) - anatomy and physiology of the pharynx and larynx.





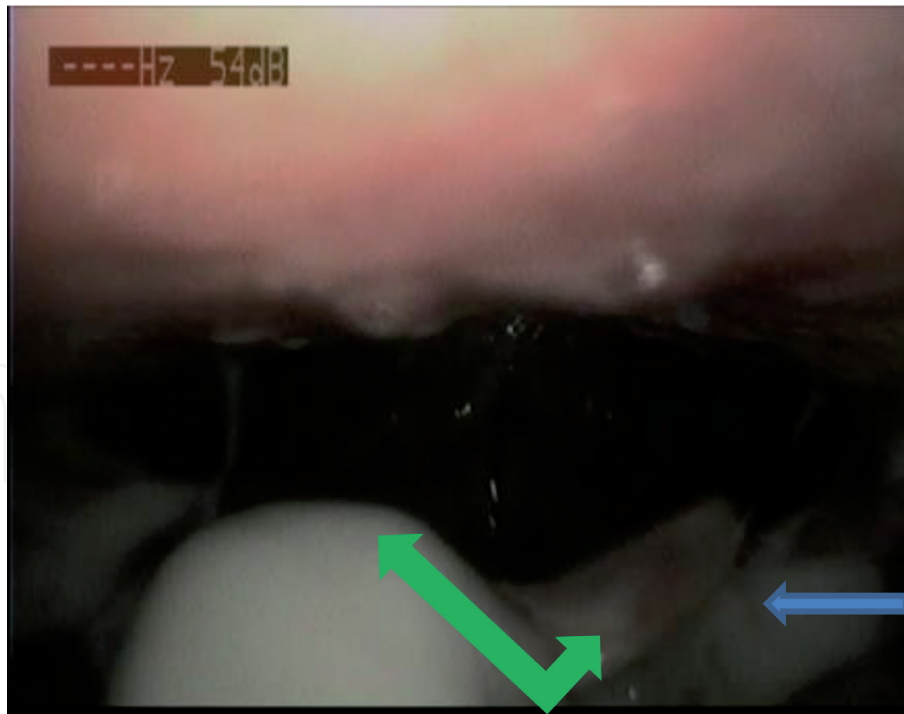
**Figure 4.**  
Fiberoptic endoscopic examination of swallowing (FEES) - swallowing of different food consistency.



**Figure 5.**  
Fiberoptic endoscopic examination of swallowing (FEES) - liquid penetration (blue arrow), residue in the piriform sinuses (green arrows).

- penetration (bolus enters the laryngeal vestibule, but does not cross the vocal folds) in 3 patients (10.00%) for liquid, 2 (6.67%) for puree, and in 1 (3.33%) for solid food
- aspiration (bolus passes below the vocal folds) of liquid in 1 patient (3,33%)
- in PAS scale, 5 patients (16.67%) reached second or third level, which means that bolus entered the laryngeal vestibule but remain above the vocal folds, with or without expectoration
- eight patients experienced episodes of upper esophageal sphincter opening
- in 13 subjects (20.00%) no swallowing disorders were found.

Also between the FEES and WST some associations were found. The 5 ml WST result was found to be positive only in patients with retention of thick mucus in



**Figure 6.**  
*Fiberoptic endoscopic examination of swallowing (FEES): Spillage (green arrows), residue in the piriform sinuses (blue arrow).*

nasopharynx ( $p = .015$ ). Half of the patients with 10 ml positive WST result presented risk of aspiration ( $p = .014$ ), and only in 1 patient out of 18 with no FEES abnormal findings the 10 ml WST result was positive ( $p = .02$ ). All patients with weakened squeeze maneuver presented positive 20 ml WST result ( $p = .025$ ). For 90 ml WST no statistically significant results were found.

## 5. Discussion

According to various recommendations the diagnostic process of chronic cough usually begins with the exclusion of the pulmonary ailments (asthma, eosinophilic bronchitis, lung cancer, Chronic Obstructive Pulmonary Disease (COPD), inflammatory lung diseases, etc.), iatrogenic causes (drug-induced cough), and next gastrointestinal (gastroesophageal reflux), and laryngological or phoniatic problems [9–11, 22, 23]. There is also as a new disease called Chronic Cough Hypersensitivity Syndrome (CCHS), characterized by cough attacks lasting more than 8 weeks, aggravated upon exposure to specific factors i.e. cold fluids, poorly responsive to treatment, and with no links to the general health status of the patient [22]. In their study, Sandhu et al. [23] mentioned about the possible relation between chronic cough and dysphagia, in particular between presbyphagia and increased stiffness of the pharyngeal walls. Langmore et al. [18] described endoscopic examination of swallowing disorders in 1988, however, it was not until now routinely used to assess dysphagia as the cause of chronic cough.

The results of our study revealed dysphagia in little more than a half of the patients with chronic cough (56.67%). The patients presented episodes of spillage, double swallows, penetration, aspiration and residue of food at the hypopharynx, which are an indirect evidence of oral stage of swallowing disturbances, and direct evidence of pharyngeal phase of swallowing problems. The results of functional assessment correlated with the WST results, which seems logical – the external laryngeal muscles take part in the laryngeal elevation and their increased tension

makes it difficult for the upper pharyngeal sphincter to open thus promoting retention (residue) at the level of the hypopharynx. Decrease in the elevation of the larynx was correlated with the 5 ml WST results.

The correlation between FEES and WST results was found for aspiration risk, spillage, and retention of saliva. It is known that pharyngeal retention of saliva is associated with impaired sensation in the critical region of the hypopharynx and larynx. The retention is slightly higher in patients with laryngopharyngeal reflux, which was found in all patients in the study group. It may be associated with an increased risk of serious swallowing disorders such as penetration or aspiration. In case of reduced sensation in the pharynx a chance of liquid or food penetration/aspiration to upper airways increases, especially when it resides in the hypopharynx and leads to multiswallows. However, more studies in larger group of patients should be conducted.

In their retrospective study, Drozd et al. [24] investigated the group of 15 patients with upper airways problems and found chronic cough in 40% of them. They used videofluoroscopy to assess dysphagia and showed correlation between degree of dysphagia and penetration, aspiration (the more severe dysphagia the higher score in PAS scale), and multiswallows. The authors believe that the dysphagia in this group of patients may be caused by incoordination between breathing and swallowing. In our study, the lower elevation of the larynx and increased muscle tension in the neck may confirm this hypothesis. Most authors involved in the problem of chronic cough highlights the difficulty not only with its diagnostics, but also with treatment [9, 11, 25–28]. There are a few reports in the literature about decrease of symptoms after speech therapy [4, 25]. It seems that the severity of dysphagia should be decreased after a treatment, which relaxes the external muscles of the larynx, however, it requires further study.

Taking into consideration that chronic cough can be harmful for larynx, the functions of the larynx will be more disturbed. The vocal folds oedema, hemorrhage, granuloma or other organic lesions can have an impact on vocal folds contraction (decreased defense reflex) [29]. Shorter maximal phonation time associated with dysphonia and chronic cough have an impact on swallowing and breathing function discoordination [30]. In that case non-pharmacological therapy can be applied, mainly forced/dry swallow, sipping water, chewing gum, sucking non-medical sweets, abdominal breathing pattern technique, cough control breathing technique exercise and physiotherapy which reduce upper body shoulder and neck tension, nasal breathing. Avoiding of irritants is also recommended. In case of risk of aspiration Mendelshon maneuver, suprahyoid muscle exercise (Shaker technique) [31] and lax vox technique is recommended [32].

The small group of patients and the lack of control group are the weak points of our study. However, to our best knowledge, this is the first study to assess the problem of dysphagia as a risk factor of chronic cough and we have been still working and collecting more data from patients and controls to analyze the results in much bigger group.

## **6. Conclusions**

The results of the study showed prevalence of dysphagia in most patients with chronic cough. It seems that phoniatic assessment in those cases should be expanded and the following tests should be performed: assessment of the laryngeal elevation, WST, and FEES. It seems important to also investigate how rehabilitation techniques used by phoniatic specialists and speech therapists improve functional outcome and quality of life in patients with chronic cough.

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## Conflict of interest

The authors declare no conflict of interest.

## Statement of ethics

The study was approved by the local Ethics Committee Review Board at the Medical University (no. KB/39/A/2016). All subjects gave their written informed consent to participation in the study.

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