Indian Journal of Otolaryngology and Head & Neck Surgery (2023) 75:2131–2136
https://doi.org/10.1007/s12070-023-03656-x

ORIGINAL ARTICLE

Self-perception of Voice Handicap in COVID 19 Patients

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Received: 2 February 2023 / Accepted: 28 February 2023 / Published online: 29 April 2023

Abstract
Voice abnormalities were reported in patients during the course of COVID-19 infection. This study aims to evaluate the effect of COVID 19 infection on the self-perception of voice handicap in positive COVID 19 patients in addition to investigating the factors that might correlate with voice handicap if present. Voice handicap index-10 was filled in by 200 patients that were confirmed to be COVID 19 positive based on the RT-qPCR and symptomatology of the disease. The result showed that about 65.5% had mild degree of COVID 19 and 27.5% had moderate degree. Dysphonia was reported by 19% of the patients when questioned about voice symptoms. Dysphonia was detected in 35% of them by auditory perceptual assessment. Symptoms of Dyspnea, dysphonia, headache were significantly correlated with total and subtotal scores of Voice handicap index. COVID 19 infection has a negative impact on some of the patients' self- perception of voice handicap on the functional, physical and emotional domains. Age and degree of COVID 19 severity were correlating with the patients' self -perception of voice handicap.

Keywords Dysphonia · COVID 19 · RT-qPCR · Voice handicap index · Auditory perceptual assessment.

Introduction

The universal outbreak of COVID-19 led to the occurrence of otolaryngological manifestations of this infection mainly related to loss of smell and taste. Many other otolaryngological symptoms are predominant in COVID-19 [1]. Voice-related symptoms as laryngeal sensitivity and vocal changes were described [2].

In a recent study, dysphonia was reported in 26.8% of patients with mild-to-moderate COVID-19 while aphonia was reported in 3.7% of patients [3]. In a study by Yasien et al. [4], 262 (72%) COVID-19 patients had phonasthenic manifestations. The most common predisposing factors to the persistence of phonasthenia as an impaired voice condition are poor physical condition, and generalized fatigue which are the most frequent symptoms type after COVID-19 [5]. Carfi et al. [6] found that 53% of COVID-19 patients experienced fatigue and 43% reported dyspnea. The association between chronic fatigue and impaired voice condition was reported in a study on young singers [7].

It is known that respiratory weakness can modify the vocal patterns, influencing the maintainability of vocal production and the efficient use of the breath is essential for healthy phonation [8]. In the study of Yasien et al. [4] revealed that in discharged COVID-19 patients, phonasthenia is a common complaint and it should be considered a symptom of the disease. Physicians have to keep in mind that COVID-19 patients may develop voice related abnormalities throughout the clinical course. Abnormal signs and symptoms that persist for more than 2 weeks after the onset of COVID-19 and do not resolve may have potential long-term effects [9]. These symptoms occur in severe cases of COVID-19, and long-lasting effects also occur in mild infection [10].

Perceptual approaches are widely used for evaluation of voice difficulties [11]. Although there are various tools that were developed to measure the quality of life, the voice handicap index (VHI) is considered one of the most accepted and recognized self-assessment tool for voice abnormalities [12]. It is important to investigate the self-perception of any sort of voice handicap in patients as an effect of COVID 19 infection to determine if there is any abnormality. Thus, it

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is possible to contribute to the management of the condition and maximize the functional recovery of patients [13] in addition to equipping the patients with the voice hygienic measures that may help resolve of symptoms and prevent the condition deterioration.

Few studies addressed the voice abnormalities in COVID 19 patients in Egypt but no study addressed the patients' perception of their voice handicap during infection. The current study aims to evaluate the effect of COVID 19 infection on the self-perception of voice handicap in positive COVID 19 patients to determine if there is any effect of the disease on voice that should be put into consideration in the therapy protocols in addition to investigating the factors that correlate with voice handicap if present.

Materials and Methods

Population of Study

The study involved a group of patients of both sexes who sought advice at Kasr Al Ainy and Fever Hospitals and were confirmed to be COVID 19 positive based on PCR and symptomatology of the disease. Diagnosis of COVID-19 was based on WHO interim guidance, nasopharyngeal swabs were collected in suspected patients and the virus was identified through reverse transcription polymerase chain reaction (RT-PCR) analysis and laboratory findings. A written informed consent was signed by the patients before participating in the study. The patients were selected in the active period of the infection in their first week in the disease course. The patients were grouped according to severity of the symptomatology and signs of the disease, based on the Egyptian Ministry of Health (MOH) Guidelines for diagnosis and treatment of COVID-19, Version [14], into mild, moderate and severe groups for later comparative purpose. Asymptomatic COVID 19 patients and those with a history of respiratory disorders or other health illness that has a negative impact on voice and communication before COVID were excluded from the study. The study was approved by the ethical committee of Otolaryngology Department and the ethical committee of Cairo University under reference number of N-147-2022.

Methodology

Patients presented to or admitted at Kasr Al Ainy hospital or Fever hospitals were interviewed and informed about the study procedures. Definitive confirmed diagnosis of COVID-19 patients was done by the reverse-transcription quantitative polymerase chain reaction (RT-qPCR) according to the nationally recommended protocol, using RNA extracted, RNA extraction was done by (Perkin Elmer –Uk) on (Chemagic d 360-UK), Amplification and detection was done by (V2 Thermofischer – UK) on (QUANTI STUDIO 5 real time PCR-UK). A history was taken involving personal history, the onset, course, duration and severity of the current complaint and symptoms, the received medical treatment, the perception of oxygen therapy, and the past history of respiratory or chronic illness. This is performed by two clinicians who are experienced in dealing with COVID 19 patients. Oxygen saturation was measured and the results of CT lung were recorded at time of the interview. Auditory-perceptual voice assessment (APA) was performed on the running speech of voice recording about their current symptoms and concerns. Two phoniatricians who have at least 15 years of experience in the evaluation of voice disorders, blindly assessed all voice samples. The evaluation was done in sound treated room. An average score of the degree of dysphonia was calculated.

The patients were asked to fill in the voice handicap index (VHI) questionnaire-Arabic version [15] by themselves or by their caregivers. It consists of 10 items covering functional, physical, and emotional aspects of voice disorders. The patients were given a score on a 5 point scale from 0 (never) to 4 (always). The total score is out of 40.

Statistical Analysis

The sample size calculation was done using "'statistics and sample size pro'" considering the mean VHI score is 2.48 with standard deviation 3.81 for study group compared to 0.95 with standard deviation 2.4 in control group (28). Alpha error 0.05 and the power is 80%. Sample size should include 68 patients.

Data were then transferred after coding to the SPSS, version 26 (IBM, SPSS, USA) for statistical analysis. Quantitative variables were non normally distributed that were described by mean and standard deviation. Frequencies and percentages were used for qualitative ones. For comparison chi square test and fisher exact test were used for qualitative variables. Non- parametric tests were done. Mann-Whitney test was used in case of classification by gender. Kruskal Wallis test was used in classification by severity, grade and spo2. Bivariate Spearman's rho was used for correlation. Correlation coefficient (r) less than 0.19 is negligible while above 0.8 is very strong. P value < 0.05 is considered significant.

Table 1 Comparison between male and female regarding the percentage of Positive COVID 19 symptoms

Positive symptoms	Male (N = 93)	Female (N = 107)	P-value
Dyspnea	21 (22.6%)	45 (42.1%)	0.003**
Cough	55 (59.1%)	69 (64.5%)	0.43
Dysphonia (symptom)	9 (9.7%)	29 (27.1%)	0.002**
Fever	10 (10.8%)	26 (24.3%)	0.02*
Loss of Smell & taste	7 (7.5%)	15 (14%)	0.14
Headache	12 (12.9%)	44 (41.1%)	< 0.0001**
Myalgia	73 (78.5%)	74 (69.2%)	0.13

*Significant P value < 0.05, ** highly significant P value < 0.01

Table 2 Comparison between males and females regarding the percentages of clinical findings of PO2, CT scan and dysphonia

Abnormality	Male	Female	P-value
SpO2	13%	20.6%	0.03*
CT scan	52.7%	36.8%	0.66
Dysphonia by APA	20.4%	48.6%	< 0.0001**

*Significant P value < 0.05, ** highly significant P value < 0.01

Results

Characteristics of Subjects Under Study

The subjects aged between 20 and 69 years with a mean age of 35.17. Males represented 46.5% while females represented 53.5%. The presented COVID 19 symptoms were; myalgia in 73.5% of cases, cough in 62%, dyspnea in 33%, headache in 28%, dysphonia in 19%, fever in 18% and loss of smell and taste in 11% of cases. The majority of the patients 65.5% had mild degree of COVID 19, 27.5% of them had moderate degree and 7% had severe degree of COVID 19.

Seventeen percent of COVID 19 patients had abnormal SPO2 of mild and severe degrees. Nearly 50% of the cases had abnormal CT scan findings of mild and moderate degrees. 35% of the cases had dysphonia by APA of mild then moderate degrees.

Total VHI mean was 5.51±5.48. It is 2.56±2.6 for functional domain, 2.2±2.1 for physical domain and 0.74±1.4 for emotional domain.

Severe cases had higher means for functional (8±2.19), physical (8±2.19), emotional (4±2.19) and total voice handicap (20±6.57) than other grades of infection.

Gender based comparisons revealed that females had higher percentage regarding dyspnea, dysphonia, fever and headache (Table 1). Females had higher percentage regarding abnormal SPO2 findings and the presence of dysphonia by APA (Table 2). Females had higher percentages of mild and moderate dysphonia degrees while males had higher percentages of normal and severe degree of dysphonia (Table 3). Females are higher than males regarding the physical, emotional and total VHI scores (Table 4).

Table 3 Comparison between males and females regarding the grades of dysphonia by APA

Grade	Male (N = 93)	Female (N = 107)	P-value
Normal	74 (79.6%)	53 (49.5%)	< 0.0001**
Mild	11 (11.8%)	32 (29.9%)	
Moderate	3 (3.2%)	20 (18.7%)	
Severe	5 (5.4%)	1 (0.9%)	

** Highly significant P value < 0.01

Table 4 Comparison between males and females regarding the means of DHI and its domains

VHI-I	Male Mean ± SD	Female Mean ± SD	P value
Functional	2.19±2.3	2.87±2.79	0.11
Physical	1.91±2.19	2.48±2.13	0.011*
Emotional	0.48±1.31	0.96±1.49	0.001**
Total	4.66±5.3	6.25±5.4	0.009**

*Significant P value < 0.05, ** highly significant P value < 0.01

COVID 19 symptoms of dyspnea, dysphonia and headache are correlated with scores of the total VHI and its domains. Cough is correlated with total scores of VHI, functional and physical domains; while fever is correlated with the score of emotional domain of VHI. There was no correlation between loss of smell and myalgia with the total and subtotal scores of VHI (Table 5).

The total score of VHI and scores of its domains are correlated with age, COVID 19 grade of severity, findings of CT scan and grade of dysphonia by APA (Table 6).

Discussion

COVID 19 infection causes inflammation of the respiratory tract causing a loss of sense of smell, fever and cough [16]. These symptoms were reported in the current study. Dysphonia was also reported in the current study due to presence of symptoms that have a negative impact on the functions of vocal tract as cough reported in 62%, and dyspnea reported in 33% of our patients. Dysphonia was reported as a major symptom of COVID-19 disease in 25–79% in previous studies [17, 18]. Only 19% of subjects under this study reported dysphonia when they were questioned about their voice problems. The percentage is lower than other studies due to difference in the severity degrees of COVID 19 infection. Our patients under-reported dysphonia, although more patients (about 35%), were clinically found by APA to have dysphonia of mild and moderate degrees. The patients might be bothered by the other symptoms of COVID 19 infection or might consider dysphonia as a part of the generalized disease weakness.

Table 5 Correlation of VHI and its domains with COVID 19 symptoms

Correlation (r) between	Total VHI	Functional VHI	Physical VHI	Emotional VHI
Dyspnea	R = 0.454 P = < 0.0001**	R = 0.382 P = < 0.0001**	R = 0.536 P = < 0.0001**	R = 0.276 P = < 0.0001**
Cough	R = 0.274 P = < 0.0001**	R = 0.313 P = < 0.0001**	R = 0.193 P = < 0.0001**	R = 0.022 P = 0.75
Dysphonia (symptom)	R = 0.531 P = < 0.0001**	R = 0.499 P = < 0.0001**	R = 0.454 P = < 0.0001**	R = 0.519 P = < 0.0001**
Fever	R = 0.057 P = 0.424	R = 0.035 P = 0.62	R = 0.006 P = 0.933	R = 0.207 P = 0.003**
Smell	R= -0.033 P = 0.64	R = 0.009 P = 0.89	R=-0.076 P = 0.28	R = 0.063 P = 0.37
Headache	R = 0.33 P = < 0.0001**	R = 0.324 P = < 0.0001**	R = 0.270 P = < 0.0001**	R = 0.273 P = < 0.0001**
Myalgia	R=-0.06 P = 0.399	R= -0.014 P = 0.84	R= -0.083 P = 0.24	R=-0.079 P = 0.26

** Highly significant P value < 0.01

Table 6 Correlation of VHI and its domains with age, grades of clinical and radiological findings

Correlation (r) between	Total VHI	Functional VHI	Physical VHI	Emotional VHI
Age	R = 0.475 P = < 0.0001**	R = 0.425 P = < 0.0001**	R = 0.396 P = < 0.0001**	R = 0.360 P = < 0.0001**
COVID 19 severity	R = 0.707 P = < 0.0001**	R = 0.658 P = < 0.0001**	R = 0.613 P = < 0.0001**	R = 0.532 P = < 0.0001**
Spo2	R = 0.559 P = < 0.0001**	R = 0.517 P = < 0.0001**	R = 0.556 P = < 0.0001**	R = 0.542 P = < 0.0001**
Grade of dysphonia by APA	R = 0.787 P = < 0.0001**	R = 0.690 P = < 0.0001**	R = 0.675 P = < 0.0001**	R = 0.739 P = < 0.0001**
CT scan	R = 0.479 P = < 0.0001**	R = 0.516 P = < 0.0001**	R = 0.495 P = < 0.0001**	R = 0.126 P = < 0.0001**

** Highly significant P value < 0.01

Our results revealed the higher the degree of COVID-19 infection severity, the higher the scores of total and subtotal scores VHI. This is due to the increase in the severity of the accompanying symptoms of the infection and the lung affection which affect the subglottal pressure and the glottal airflow responsible for the voice production. In a previous study, a significant positive association was found between dysphonia and cough [19]. Voice disorders are commons in viral infections of the upper respiratory tract resulting from neuronal infection, vocal folds inflammation, pulmonary function deficit, and ventilatory support complications [20].

In a previous study, the VHI-10 questionnaire was used for patient-reported vocal outcomes. Its total score was higher in patients with COVID-19 [21]. However, their average total VHI-10 score was 7.31 ± 6.67; slightly higher than in the current study 5.51±5.48. However, our result was higher than Golac et al' study [22] (2.48 ± 3.81) which was conducted on patients in the recovering period. The possible reason may be due to the difference in the time of evaluation. The symptoms encountered during the respiratory tract infections alter the basic characteristics of voice [23].

In the current study, females had clinically higher percentage of dysphonia by APA than males in addition females reported higher scores than males regarding the physical, emotional and total VHI scores (Tables 2, 3 and 4). This is related to that gender differences related to laryngeal physiology, hormone differences, non-laryngeal physiology, and non-physiological or behavioral characteristics that made females more vulnerable to voice problems and is exacerbated by the presence of COVID 19 [24]. It is possible that this gender difference may reflect the tendency for women to report vocal symptoms more than men [25] as well as distinct gender general approaches to reporting symptoms and completing questionnaires [24]. This could relate to a gender-related difference in the inflammatory process and the clinical presentation of the disease [26]. Other studies detected the differences between males and females in the immune response to COVID-19 infection and inflammatory diseases. They found that females are less susceptible to have complications based on a different innate immunity, steroid hormones and factors related to sex chromosomes. They explained the immune regulatory genes encoded by female X chromosome causes lower viral load levels with less inflammation compared with male patients [27].

Our results showed significant correlation between the symptoms of COVID 19 and the total score of VHI and its domains especially for dyspnea, dysphonia & cough (Table 5). This is supported by findings in literature [22]. Therefore we can clearly conclude that exacerbation of the symptoms causes an increase in self-reported vocal complaints and patients with COVID-19 are likely to have deterioration in voice quality during the infection period.

Scores of total VHI and its domains were significantly correlated with age, severity degree of COVID 19 infection, CT findings and degree of dysphonia by APA (Table 6). Age is a strong risk factor for COVID-19 severity as the percentage of immunocompromised people in a population is linked with the age [28]. The older the age, the more vulnerability to more severe degree of COVID 19 infection and the more the severity of the symptoms including voice problems in addition to the tendency of old aged people to report symptoms they experience explaining the raised score of total VHI across all domains. This is not in agreement with the Egyptian study [18] whose authors found no correlation between age and dysphonia. They attributed their findings to the minimal number of old patients in their study.

The significant correlation between scores of VHI and dysphonia by APA in our study (Table 6) confirms the capability of APA as the gold standard of voice evaluation [29] in detecting the degree of severity of dysphonia and its sequalae impact on the self-perception of voice handicap by our patients.

The current study managed to detect the presence of dysphonia and confirmed the presence of self-reported voice handicap in all degrees of severity in COVID 19 positive cases. However, there are some limitations raising interesting points to investigate in future studies such as applying prospective longitudinal studies on larger scale to help follow up the progress. Giving voice hygienic instructions and medical treatment protocols then follow up the cases will give insight about the effect of these measures on the regression of the condition hence referring the resistant cases to thorough instrumental evaluation.

Conclusion

Dysphonia was reported by 19% of our positive cases of COVID 19 patients. A higher percentage of cases with dysphonia was detected by APA. Females had higher degree of mild and moderate grades of dysphonia. Males had higher percentage of severe dysphonia. Symptoms of dyspnea, dysphonia and headache are significantly correlated with total and subtotal Voice handicap index scores. Scores of voice handicap index and its domains are correlated with age, COVID 19 severity, CT findings and dysphonia grade by APA. COVID 19 infection has a negative impact on some of the patients' self- perception of voice handicap and its domains. Proper voice hygienic measures and medical treatment should be included in the therapy protocols of COVID 19.

Author Contributions HMF constructed the idea, tabulated the data and edited the manuscript, AG performed the diagnosis of COVID 19 and collected the data, MA interviewed the patients and collected the data, AFA interpreted the results and wrote the manuscript. All authors read and revised the manuscript.

Funding This research did not receive any specific grant for funding agencies in the public, commercial or not-for-profit sectors.

Availability of Data and Materials The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Declarations and Statements

Competing Interests The authors declare no conflicts of interest.

Ethics Approval and Consent to Participate A written consent was taken from all the patients. This study was approved by the Ethics Committee of Ear, Nose and Throat Department, and the ethical committee of faculty of medicine, Cairo University. The study and data collection were conformed to all local laws and were compliant with the principles of the Declaration of Helsinki. Committee reference number is N-147-2022.

Consent for Publication Not applicable.

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