Accuracy of clinical examination findings in the diagnosis of COPD*

Acurácia do exame clínico no diagnóstico da DPOC

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Abstract

Objective: Simple diagnostic methods can facilitate the diagnosis of COPD, which is a major public health problem. The objective of this study was to investigate the accuracy of clinical variables in the diagnosis of COPD. **Methods:** Patients with COPD and control subjects were prospectively evaluated by two investigators regarding nine clinical variables. The likelihood ratio for the diagnosis of COPD was determined using a logistic regression model. **Results:** The study comprised 98 patients with COPD (mean age, 62.3 ± 12.3 years; mean FEV_1, 48.3 ± 21.6%) and 102 controls. The likelihood ratios (95% CIs) for the diagnosis of COPD were as follows: 4.75 (2.29-9.82; p < 0.0001) for accessory muscle recruitment; 5.05 (2.72-9.39; p < 0.0001) for pursed-lip breathing; 2.58 (1.45-4.57; p < 0.001) for barrel chest; 3.65 (2.01-6.62; p < 0.0001) for decreased chest expansion; 7.17 (3.75-13.73; p < 0.0001) for reduced breath sounds; 2.17 (1.01-4.67; p < 0.05) for a thoracic index ≥ 0.9; 2.36 (1.22-4.58; p < 0.05) for laryngeal height ≤ 5.5 cm; 3.44 (1.92-6.16; p < 0.0001) for forced expiratory time ≥ 4 s; and 4.78 (2.13-10.70; p < 0.0001) for lower liver edge ≥ 4 cm from lower costal edge. Inter-rater reliability for those same variables was, respectively, 0.57, 0.45, 0.62, 0.32, 0.53, 0.32, 0.59, 0.52 and 0.44 (p < 0.0001 for all). **Conclusions:** Various clinical examination findings could be used as diagnostic tests for COPD.

Keywords: Physical examination; Diagnosis; Pulmonary disease, chronic obstructive.

Resumo

Objetivo: A DPOC é um problema de saúde pública, e métodos diagnósticos simples podem ser úteis para facilitar o diagnóstico desta doença. O objetivo deste estudo foi avaliar a acurácia de variáveis clínicas para o diagnóstico de DPOC. **Métodos:** Pacientes com DPOC e controles foram prospectivamente avaliados por dois examinadores quanto a nove variáveis clínicas. A razão de verossimilhança para o diagnóstico de DPOC foi determinada utilizando-se o modelo de regressão logística. **Resultados:** Foram incluídos 98 pacientes com DPOC (idade média, 62,3 ± 12,3 anos; VEF_1 médio, 48,3 ± 21,6%) e 102 controles. A razão de verossimilhança e IC95% para o diagnóstico de DPOC foram: 4,75 (2,29-9,82; p < 0,0001) para uso da musculatura acessória; 5,05 (2,72-9,39; p < 0,0001) para respiração com os lábios semicerrados; 2,58 (1,45-4,57; p < 0,001) para tórax em barril; 3,65 (2,01-6,62; p < 0,0001) para redução da expansibilidade torácica; 7,17 (3,75-13,73; p < 0,0001) para redução do murmúrio vesicular; 2,17 (1,01-4,67; p < 0,05) para índice torácico ≥ 0,9; 2,36 (1,22-4,58; p < 0,05) para comprimento laríngeo ≤ 5,5 cm; 3,44 (1,92-6,16; p < 0,0001) para tempo expiratório forçado ≥ 4 s; e 4,78 (2,13-10,70; p < 0.0001) para limite inferior do fígado ≥ 4 cm abaixo do rebordo costal. A concordância entre observadores para as mesmas variáveis foi, respectivamente, 0,57, 0,45, 0,62, 0,32, 0,53, 0,32, 0,59, 0,52 e 0,44 (p < 0,0001 para todas). **Conclusões:** Vários achados do exame clínico podem ser utilizados como testes diagnósticos para DPOC.

Descritores:: Exame físico; Diagnóstico; Doença pulmonar obstrutiva crônica.

Introduction

The progressive illness known as COPD is characterized by airflow limitation that is not fully reversible. It is known that COPD is associated with an abnormal inflammatory response in response to exposure to certain noxious gases or particles, principally due to smoking.[1] In a study conducted in 5 cities in Latin America,[2] it was observed that the prevalence of this disease, in adults over 40 years of age, was between 7.8% and 19.7%.

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The pulmonary emphysema and chronic bronchitis components of the disease are both present, in variable proportions, in the majority of patients with COPD. The destruction of the lung parenchyma that occurs in emphysema promotes a reduction in the elasticity that maintains the airway diameter, resulting in increased airflow resistance. In chronic bronchitis, the increased bronchial wall thickness and the greater production of mucus (resulting from the chronic airway inflammation) both promote bronchial obstruction. The greater airflow resistance during exhalation, resulting from the inverse, exponential relationship between the airway diameter and the airflow resistance, causes air trapping and hyperinflation. In the initial phases of the disease, these pathophysiological alterations not give rise to any modification in the physical examination that is relevant for the diagnosis of COPD.[3] In the more advanced forms of the disease, various signs appearing in the physical examination reflect the permanent hyperinflation and the modifications in the respiratory mechanics.

Despite the fact that the description of pulmonary emphysema in autopsies dates from the 17th century, and that the first clinical descriptions of this disease were made by Laennec approximately 200 years ago, we still do not know with certainty how much weight to assign to these physical examination findings.[4]

In 1927, Cabot reported that, among patients in whom emphysema was an autopsy finding, the disease had been recognized prior to death in only 5%, and that, of the patients diagnosed based on clinical criteria, only 25% presented emphysema at autopsy.[5] The use of spirometry findings as diagnostic criteria made it possible to evaluate the accuracy of various clinical signs for the diagnosis of COPD. Fine inspiratory rales,[6,7] absence of cardiac dullness to percussion,[8] reduced breath sounds,[9,10] heart sounds over the xiphoid process,[8,11] Hoover's sign,[12-14] wheezing during spontaneous breathing,[8,11,15] chest hyperresonance,[8] barrel chest[16] and pulsus paradoxus,[17] as well as increased forced expiratory time,[18] have been identified as predictors of COPD. Normal breath sound intensity[9,10] and a forced expiratory time less than 3 s[17] have been found to be negative predictors of COPD. Some studies have evaluated the accuracy of the clinical impression (the capacity to integrate all of the observations made during the physical examination). One group of authors demonstrated that the physical examination presents moderate diagnostic accuracy (OR = 4.2), although only in the more severe forms of COPD.[11] Others reported better accuracy (OR = 7.3).[8]

However, there can be considerable variability in the evaluation among investigators, and that can limit the weight given to the clinical examination in this situation. In one study,[16] the sensitivity of the clinical diagnosis ranged from 15% to 95%. However, few studies have evaluated, in conjunction, multiple variables in samples that were well characterized from a clinical and functional standpoint. The present study was a controlled, prospective study, the objective of which was to analyze the accuracy of and the inter-rater reliability for nine clinical variables in the diagnosis of COPD.

Methods

Patients who were hospitalized or were referred as outpatients to the Pulmonary Function Laboratory of the Pulmonology Department of the Nossa Senhora da Conceição Hospital, located in the city of Porto Alegre, Brazil, were examined consecutively until the projected number (200 patients, half with COPD and half without) had been obtained. After undergoing spirometry, the patients selected were evaluated by two to four medical students, specifically and simultaneously trained for this study. The medical students were blinded to the spirometry findings. The following variables were studied: a) laryngeal height, measured with the patient seated, between the upper limit of the laryngeal cartilage and the sternum; b) reduced chest expansion (present or absent); c) bilateral reduction in breath sounds (present or absent); d) forced expiratory time, measured through auscultation of the sternal region after a maximal inspiratory maneuver, patients being instructed to put forth the maximum effort to empty the lungs completely; e) distance between the lower costal edge and the lower edge of the liver, measured with the aid of percussion and palpation; f) ratio between the anteroposterior and lateral diameters of the chest; g) characterization in the anamnesis (at any frequency) or identification in the physical examination of the occurrence of pursed-lip breathing; and h) characterization in the anamnesis (at any frequency) or identification in the

physical examination of the use of the scalene and sternomastoid muscles, defined as a specific attitude of patients to voluntarily use their arms or elbows to provide support. We defined the presence of COPD as an FEV_1/FVC ratio < 70%, obtained through spirometry, in patients with a smoking history of > 10 pack-years. The cases in which these criteria were not met were considered control subjects.

The comparison between the patients with COPD and the control subjects in terms of the clinical variables was conducted using a logistic regression model, and the likelihood ratios for the diagnosis of COPD were determined for all of the variables studied. Inter-rater reliability was evaluated using the kappa statistic. Differences presenting the probability of an alpha error of less than 0.05 were considered significant. The data were analyzed using the program Statistical Package for the Social Sciences, version 14.0 (SPSS Inc., Chicago, IL, USA).

Results

We studied 98 COPD patients and 102 control subjects. The characteristics of the patients are shown in Table 1. The COPD patients that had a history of chronic cough and those that had a history of dyspnea presented a mean FEV_1 (in % of predicted) of 40.1 ± 17.7 and 39.1 ± 16.6, respectively. Those without a history of cough and those without a history of dyspnea presented a mean FEV_1 (in % of predicted) of 48.4 ± 23.3 and 68.8 ± 23, respectively. Table 2 shows the likelihood ratios for the diagnosis of COPD. The following variables, identified in the anamnesis or in the physical examination, were analyzed: the use of the scalene and sternomastoid muscles; pursed-lip breathing; barrel chest; symmetric reduction in chest expansion; diffuse reduction in the breath sounds; ratio between the anteroposterior and lateral diameters ≥ 0.9; laryngeal height ≤ 5.5 cm; forced expiratory time ≥ 4 s; and distance between the lower costal edge and the lower liver edge ≥ 4 cm. The inter-rater reliability is also described in Table 2.

The logistic regression for all of the variables combined showed that, for rater 1, the only variables that maintained statistical significance were pursed-lip breathing (p = 0.005), forced expiratory time ≥ 4 s (p = 0.003), diffuse reduction in the breath sounds (p = 0.002), symmetric reduction of chest expansion (p = 0.004) and the lower liver edge ≥ 4 cm from the lower costal edge (p = 0.004). Use of the scalene and sternomastoid muscles presented borderline significance (p = 0.059). The logistic regression for all of the variables combined showed that, for rater 2, the only variables that maintained statistical significance were forced expiratory time ≥ 4 s (p = 0.001), diffuse reduction in the breath sounds (p = 0.006) and lower liver edge ≥ 4 cm from the lower costal edge (p = 0.005).

Discussion

In view of the fact that COPD is a public health problem, methods that are rapid and do not add to the cost of care, such as a identification of diagnostic findings in the physical examination, can be useful for allowing secondary prevention measures to be taken a more timely manner. Therefore, establishing the efficacy of the clinical diagnosis becomes highly relevant, since greater clinical suspicion can increase the number of cases in which diagnostic confirmation is obtained through spirometry. Each piece of information collected during anamnesis or during the physical examination can be considered a diagnostic test and, therefore, the physician should select the data that are the most appropriate for the diagnosis.

As mentioned in the Introduction, various clinical signs have previously been studied, some decades ago. However, when the methodology

Table 1 - Characteristics of the patients.

Variable	Group with COPD	Control group
Patients, n	98	102
Gender, M/F	66/32	52/50
Age,[a] years	62.3 ± 12.3	55.2 ± 13.6
Smokers/former smokers, n (%)	98 (100)	77 (75.5)
Never smokers, n (%)	0	25 (24.5)
Smoking,[a] pack-years	56.2 ± 36.6	43.8 ± 33.1
Chronic cough, n (%)	52 (53.1)	26 (25.5)
Dyspnea, n (%)	78 (79.6)	56 (54.9)
Post-BD FVC,[a] % of predicted	74.1 ± 22.8	87.6 ± 22.9
Post-BD FEV_1,[a] % of predicted	48.3 ± 21.6	85.9 ± 21.3
FEV_1/FVC,[a] % of predicted	51.3 ± 11.7	81.2 ± 7.2

Post-BD: after the use of a bronchodilator. [a]Values expressed as mean ± SD.

employed in some studies is subjected to a critical analysis, a number of limitations can be identified. Such methodological shortcomings include the lack of a control group of patients without COPD, which would allow the specificity of the finding to be evaluated, different approaches to the statistical analysis, the inclusion of patients with asthma, the lack of spirometric confirmation of obstructive lung disease, small sample size and the failure to evaluate inter-rater reliability.

In the present study, all of the clinical signs studied presented high likelihood ratios for the diagnosis of COPD and, consequently, can be used in order to identify individuals with the disease. The confirmation that the physical examination can provide the fundamental elements for the diagnosis of COPD does not preclude the need to perform spirometry, be it for the diagnostic confirmation or for the staging. In fact, greater clinical suspicion will effectively result in a greater number of cases diagnosed.

One obstacle to the interpretation of the importance of our results is related to the characteristics of the patients studied, since many of the patients in our sample had severe COPD. It is obviously easier to demonstrate the COPD-related alterations in the clinical examination when the disease is more severe, given that most of the physical examination findings result from hyperinflation, which is greater in the more advanced forms of the disease. However, a greater benefit would be expected if the clinical diagnosis could be established in the early phases of COPD, thereby creating the possibility of determining a strategy for the diagnostic confirmation and for the intervention in the natural history of the disease at its onset. However, as is well known, the alterations in the physical examination are not apparent at that time. Therefore, we should emphasize the importance of performing spirometry in smoking patients with respiratory symptoms, which can enable the early diagnosis of COPD.

We can argue that, for patients in the age bracket studied, with a history of significant exposure to tobacco and presenting respiratory symptoms, the pre-test probability is sufficient to indicate a confirmatory diagnostic test—spirometry—manifestations of the disease in the physical examination being of little importance. Nevertheless, the identification of an abnormality in the clinical examination can function at least as a motivation to seek diagnostic confirmation of the COPD. For example, in a study of twelve physical examination signs,[8] only reduced breath sounds was found to add diagnostic power to a smoking history ≥ 70 pack-years, showing that the most important factor for diagnostic suspicion is the identification of the presence of smoking. However, the diagnosis of COPD was confirmed in only 8 of the patients studied, another 19 patients being classified as probable cases of COPD, which made it impossible to perform an appropriate statistical analysis for the twelve variables simultaneously.

In the present study, conducted with a number greater of patients and with a control group, many patients who were smokers and had respiratory symptoms did not present spirometry findings consistent with obstructive lung disease, and their symptoms were found to have another origin. The physical examination can distinguish between such patients and those with COPD. Therefore, the clinical evaluation should be valued as a diagnostic element and can strengthen the recommendation to perform spirometry in cases in which the possibility of COPD is greater. As

Table 2 - Clinical diagnosis of COPD.

Variable	Likelihood ratio[a]		Reliability[+]
	Rater 1	Rater 2	
Scalene/sternomastoid muscle use	4.75 (2.29-9.82)♦	3.78 (2.05-6.79)♦	0.57♦
Pursed-lip breathing	5.05 (2.72-9.39)♦	2.6 (1.51-4.27)**	0.45♦
Barrel chest	2.58 (1.45-4.57)♪	2.43 (1.32-4.13)**	0.62♦
Reduced chest expansion	3.65 (2.01-6.62)♦	2.35 (1.32-4.17)**	0.32♦
Reduced breath sounds	7.17 (3.75-13.73)♦	4.23 (2.21-8.12)♦	0.53♦
AP/L chest diameter ratio ≥ 0.9	2.17 (1.01-4.67)*	2.30 (1.07-4.92)*	0.32♦
Laryngeal height ≤ 5.5 cm	2.36 (1.22-4.58)*	1.94 (0.97-3.89)	0.59♦
Expiratory time ≥ 4 s	3.44 (1.92-6.16)♦	3.17 (1.66-6.06)♦	0.52♦
LLE ≥ 4 cm from the lower costal edge	4.78 (2.13-10.70)♦	3.34 (1.79-6.23)♦	0.44♦

AP/L: anteroposterior and lateral; and LLE: lower liver edge. [a]The values in parentheses correspond to the confidence intervals. [+]kappa statistic. *p < 0.05; **p < 0.01; ♪p < 0.001; and ♦p < 0.0001.

is well known, clinical evaluation is underutilized, for the identification of new cases as well for the staging of COPD. In addition, the inter-rater reliability observed in the present study was quite satisfactory, which allowed us to make a better estimate of the importance of the clinical scenario in the diagnosis of this disease. The need to conduct a physical examination is indisputable. Therefore, being able to tabulate the findings of physical examination in accordance with the probability of detecting the disease undoubtedly adds value to the diagnostic process, especially since the interpretation of complementary tests loses much of its importance when dissociated from the clinical context.

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