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Is Pulmonary Auscultation Alone Sufficient for Clinical Practice?

Waldo Luis Leite Dias de Mattos[1,2,3*], João Vitor Pinotti Dallasen[1], Ana Gabriela Goularte Juchem[1], Douglas da Silva Pinos[3], Fabiana Jaeger[3]

[1]Federal University of Health Sciences of Porto Alegre (UFCSPA), Porto Alegre, Brazil
[2]Santa Casa de Misericórdia Hospital, Porto Alegre, Brazil
[3]Nossa Senhora da Conceição Hospital, Porto Alegre, Brazil
Email: *waldomattos@gmail.com

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Abstract

Objective: The clinical examination is the basis for the diagnosis and rational choice of complementary tests. The aim of the study was to evaluate the performance of auscultation of the chest for screening of disease and for predicting the presence of abnormalities in the other domains of the chest examination. **Methods:** Patients with COPD, atelectasis, pleural effusion, pneumonia and controls were evaluated by two examiners in the absence of any clinical information, initially only with pulmonary auscultation, and then in the other domains of chest examination. **Results:** 192 physical examinations were performed in 104 patients. An abnormal pulmonary auscultation had a sensitivity of 85.2%, positive predictive value (PPV) of 84.1%, positive likelihood reason (LR) of 1.53 (95% CI; 1.16 to 2.01) and negative LR of 0.33 (95% CI; 0.2 to 0.56) to identify the presence of any disease, and also a positive LR of 2.23 (95% CI; 1.02 to 4.9) and a negative LR of 0.3 (95% CI; 0.17 to 0.51) to predict additional abnormalities. A normal auscultation showed low accuracy to identify healthy individuals, with sensitivity, specificity, NPV and PPV, respectively, of 44%, 43%, 41% and 46%. The agreement between the examiners considering normal versus abnormal findings showed *kappa* = 0.76 for any changes in the physical examination present ($p < 0.0001$). **Conclusions:** Auscultation of the chest alone, may not be a sufficient strategy to track diseases or establish whether continuity of the examination is necessary or not.

Keywords

Physical Examination, Pulmonary Auscultation, Clinical Diagnosis

1. Introduction

Until the middle of the last century, the clinical examination was practically the

only basis for the diagnosis and treatment of patients and subsequent studies showed that the combination of anamnesis and physical examination could lead to diagnosis in up to 88% of cases, according to the understanding at that time [1]. Despite the widespread acceptance that anamnesis provides the greatest contribution to diagnosis, some evidence has suggested that physical examination can add major elements to diagnosis in 8.7% to 17% of cases [2] [3] [4], which resulted in establishing detailed routines to offer a comprehensive examination. However, the growing appearance of complementary technologies, new understandings on the valuation of clinical findings in the management of patients and new models of doctor-patient relationship have led to a simplification of the physical examination and a consequent reduction in the time of care for patients.

In Brazil, in 2019 DATASUS registered 201.7 million outpatient medical consultations in primary and specialized care by the public health system [5] and in 2018 the National Agency for Supplementary Health [6] recorded 274.3 million consultations among beneficiaries of private health plans, which totals almost 500 million consultations every year. In the USA, it was estimated that in 2016 there were 883.7 million outpatient consultations [7].

Regarding the respiratory system, the examination routine is still taught in universities in a very similar way to what was done more than a century ago. This scenario considers the four domains of physical examination as multiple diagnostic tests and designed for interpretation as tests in parallel, considering that an abnormality anywhere is an indication of disease. Within the context of the past, this potentially allowed to increase the sensitivity and predictive value of disease assessment above the result of each separate test, which was appropriate in the absence of additional tests.

There is currently a greater emphasis on auscultation of the chest and some studies show that its performance is in fact more sensitive [8] [9] [10] [11] [12]. For other findings not related to auscultation, the results seem inferior in relation to sensitivity [13] [14] [15] [16]. Additionally, there is a significant variability in agreement between examiners, with kappa generally below 0.5, which raises doubts regarding the reliability of the information for clinical application [17].

If this is true, a thorough examination of the chest may no longer be justified and we should really start to work with the serial testing model, in which the subsequent physical examination tests are only implemented in the event of an indication of illness after auscultation. Thus, we think it is necessary to examine these possibilities in the real field of work and we decided to evaluate the performance of this strategy, which uses only auscultation as a routine initial test on the diagnosis and prediction of the need to perform the other domains of the physical examination.

2. Materials and Methods

Patients admitted to a general hospital were prospectively selected by a researcher, initially by identifying the diagnosis of hospitalization in the medical

record, but then by confirming the diagnostic criteria established by reviewing the clinical data and available complementary exams, provided they had a diagnosis of COPD, atelectasis, pneumonia, pleural effusion, or absence of lung disease. The physical examination was carried out by 2 of 4 other examiners, two medical resident doctors or two medical students, unaware of any clinical information. Initially, auscultation of the chest was performed and recorded, and later the rest of the examination, performed in accordance with current recommendations [18].

The following definition criteria were used: 1) COPD: history of smoking > 10 pack years, presence of chronic respiratory symptoms, diagnosis of COPD by the attending physician, spirometry in the last 12 months showing an FEV1/FVC post-bronchodilator < 0.7 [19]; 2) Pleural effusion: of any cause, identified by chest radiogram with frontal and lateral view in the last 3 days, with an estimated volume of at least 500 ml, defined by the obscuration of the diaphragm by the meniscus image in the frontal view [20]; 3) Atelectasis: of any cause, determined by chest radiogram with frontal and lateral view performed in the last 3 days, defined by the collapse of at least one lobe; 4) Pneumonia: diagnosis of pneumonia by the attending physician, presence of acute respiratory symptoms, leukocytosis and new pulmonary radiological infiltrate; 5) Control group: absence of respiratory disease in no smokers and normal chest X-ray.

The data were analyzed considering the number of medical exams performed and defining as a dependent variable a pulmonary auscultation (normal or abnormal) or presence of disease (absent or present), comparing according to each disease and with the findings in the other domains of physical examination. We also evaluated the effect of abnormal auscultation defined by the presence of adventitious breath sounds, regardless of the intensity and symmetry of the sounds. The data were selected according to their sensitivity, specificity, positive predictive value, negative predictive value and likelihood ratio for the meaning of the dependent variables. Agreement between examiners was assessed using the kappa coefficient. Differences with an alpha error probability less than 0.05 were significant. The data were analyzed using the IBM SPSS 2019 program. The likelihood ratio was assessed with the WINPEPI computer programs for epidemiologists and their teaching potential in 2011.

3. Results

One hundred and four patients were examined whose sociodemographic characteristics are described in **Table 1**. Of the total, 88 were seen by 2 examiners and another 16 by only one, making a total of 192 physical examinations. COPD diagnosis was observed in 27 cases, atelectasis in 20 (at least lobar), pleural effusion in 29 (at least 1/4 of the hemithorax), pneumonia in 7 and the remaining 21 did not have lung disease.

Some abnormality on physical examination was identified in 97.3% of patients with diseases of the respiratory system, but the findings showed very low specificity for detecting the disease. An abnormal auscultation had a sensitivity of

85.2% and a PPV of 84.1% to identify the presence of any disease, showing that in fact it is a tool that is useful in the clinical scenario, whereas when we consider, alternatively, as criteria for defining abnormal auscultation only the presence of ABS, we observed a lower sensitivity (Figure 1). Considering an abnormal pulmonary auscultation as a positive diagnostic test, the positive likelihood ratio to indicate disease was 1.53 (95% CI; 1.16 to 2.01) and negative likelihood ratio 0.33 (95% CI; 0.2 to 0, 56). The meaning of abnormal auscultation according to each diagnosis is detailed in Table 2.

On the other hand, the initial finding of normal pulmonary auscultation showed low accuracy to identify healthy individuals, with sensitivity, specificity, NPV and PPV, respectively, of 44%, 43%, 41% and 46% (Figure 2). In case we consider only the absence of ABS as the definition of the diagnostic pattern of the test, we observed some improvement in performance, with sensitivity, specificity, VPN and PPV, respectively, of 59%, 57%, 86% and 23%. However, the accuracy of finding normal auscultation with either of the two definition approaches remains low to be used to conclude that there is no disease in the clinical setting.

Another aspect assessed was the probability of finding abnormalities in the other domains of the physical examination (inspection, palpation and percussion) when identifying normal or abnormal auscultation, in order to assess whether it is really necessary to complete the entire physical examination of the chest. In patients whose examination identified some abnormality on auscultation, 87% showed some additional findings on inspection, 67% on vocal resonance, 78% on chest expansion, 67% on tactile fremitus and 66% on chest percussion. Abnormal auscultation had sensitivity, specificity, NPV and PPV, respectively, of 97%, 17%, 63% and 81% to indicate the presence of additional findings in the other domains of the examination (Figure 3).

Table 1. Demographic and clinical characteristics of the participants.

Gender (male/female), number	61/43
Age, years (SD)	61 (13)
Diagnosis: COPD/atelectasis/pleural effusion/pneumonia/controls	27/20/29/7/21
FEV1% predicted, mean (SD) in COPD subgroup	36% (13)

Table 2. Identification of respiratory disease by auscultation.

Diagnosis	Sn	Sp	NPV	PPV	Sn	Sp	NPV	PPV
	Abnormal Auscultation*				Presence of abnormal sounds**			
Any disease	85.2	44.2	46.3	84.1	57.4	58.6	23.6	86
PHS	90.2	44.2	82.6	60.7	67.6	58.6	58.6	67.6
ATE	76.7	44.2	67.9	53.8	60	58.6	58.6	60
CON	80	44.2	86.4	33.3	46.2	58.6	70.8	33.3
PE	89.3	44.2	76	67.6	51	58.6	41.6	67.6

*Defined by any type of abnormality; **defined exclusively by the identification of any abnormal sound. Data described in percentage.

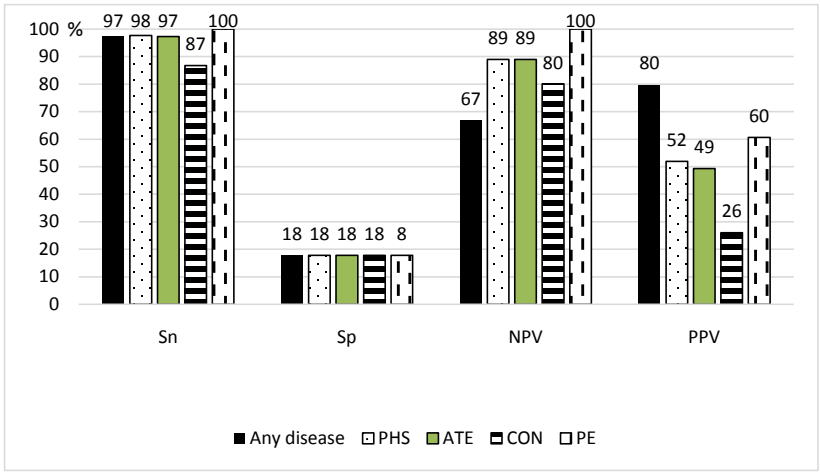

Figure 1. Identification of respiratory disease by physical examination.

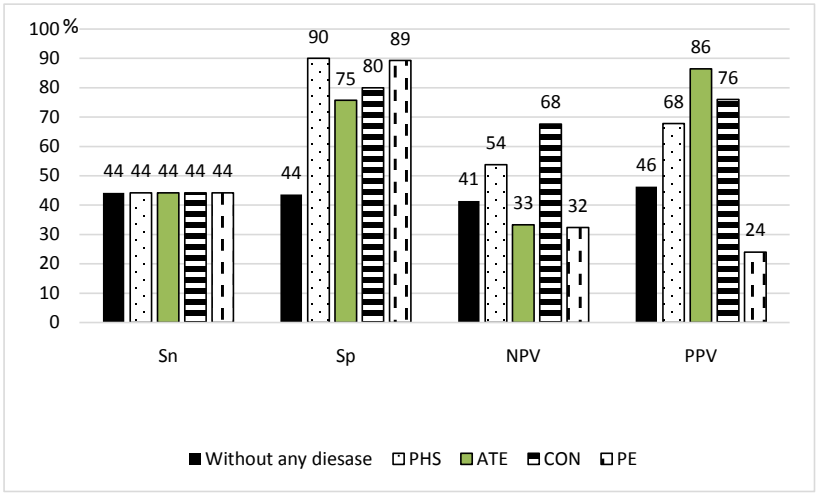

Figure 2. Meaning of normal auscultation to exclude disease. *Patients with normal lung auscultation. Data showed in percentage.

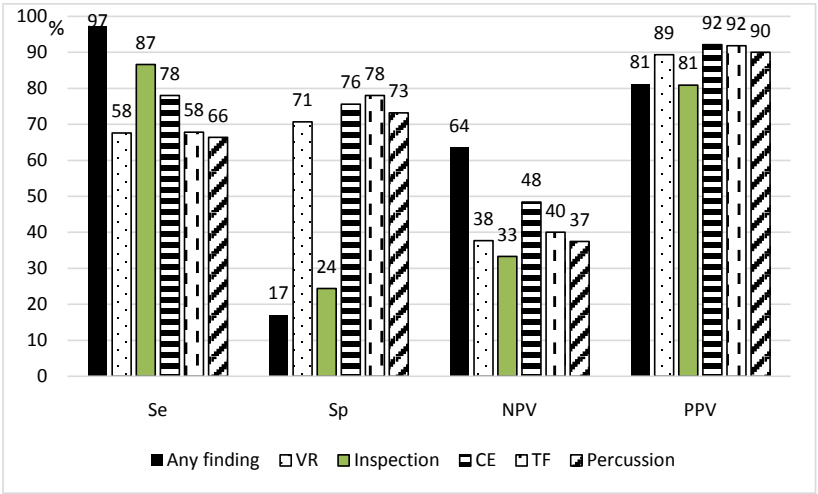

Figure 3. Meaning of abnormal auscultation to indicate the presence of additional abnormal findings in other domains of physical examination.

The positive LR of an abnormal pulmonary auscultation was 2.23 (95% CI; 1.02 to 4.9) to indicate the presence of additional abnormalities in the remaining physical examination and the negative LR was 0.3 (95% CI; 0.17 to 0.51). In the case of considering only the presence of ABS as abnormality criteria, sensitivity, specificity, NPV and PPV were, respectively, 96%, 10%, 70% and 56% to indicate the presence of other abnormalities.

Analyzing the other possibility, the finding of a normal pulmonary auscultation showed sensitivity, specificity, NPV and PPV, respectively, of 64%, 81%, 97% and 17% to indicate that the other domains of the physical examination are normal, that is, a very low PPV to choose to skip a full physical exam and consequently lose potentially useful information.

Another analysis was made considering the effect of the combined assessment of inspection and auscultation, due to the impossibility of dissociating these two assessments in a real scenario, and the presence of any abnormality in one or both domains showed similar performance than the exclusive use of auscultation, with sensitivity, specificity, NPV and PPV to indicate the presence of some disease, respectively, 97%, 11%, 50% and 79%. On the other hand, when both auscultation and inspection were normal, the performance to indicate that the individual is healthy was lower, with sensitivity, specificity, NPV and PPV, respectively, 3%, 89%, 21% and 50%.

Agreement between examiners considering normal versus abnormal findings was assessed in 88 patients and showed the following results: Kappa = 0.53 for auscultation ($p < 0.0001$); kappa = 0.44 for identification of adventitious noises ($p < 0.0001$); kappa = 0.39 for vocal resonance ($p < 0.0001$); kappa = 0.52 for inspection ($p < 0.0001$); kappa = 0.37 for thoracovocal fremitus ($p = 0.001$); kappa = 0.35 for percussion ($p = 0.001$); kappa = 0.76 for any change in the physical examination present ($p < 0.0001$).

4. Discussion

Pulmonary hyperinflation, consolidation, atelectasis and pleural effusion are the main pleuropulmonary syndromes whose diagnosis is possible through physical examination and represent a set of diseases of relevant prevalence in the respiratory system. In this study, we demonstrate the importance of physical examination in the diagnosis of these syndromes and also that it is not prudent to restrict it only to auscultation, even when combined with inspection, when we want to enjoy the best performance.

The first point to highlight is that our sample of patients does not represent diseases at an early stage, for which the accuracy of the physical examination would certainly be lower. However, the physical examination showed some abnormality in 97.3% of the patients and also revealed a homogeneous distribution with very high sensitivity for diagnosis in all the conditions studied. And it demonstrated a positive and negative likelihood ratio with statistical significance to include or exclude the diagnosis of some disease by physical examination

alone, disregarding the pre-test probability arising from the anamnesis, confirming that the physical examination effectively adds power to the clinical diagnosis.

The objective of the study was mainly to understand if it is possible to use it as a routine physical examination of the chest auscultation alone or in combination with inspection to identify if there is a disease. If these were true, it would provide support to carry out this practice, which is becoming more frequent every day, and to reduce the examination time with the patient. However, our results showed that it has low accuracy to be used as a single element of examination. The finding of normal auscultation had a low yield for the identification of healthy patients, occurring in only 46% of them, suggesting that it cannot be used as a marker of normality and the physical examination or further investigation must continue. We understand that one of the possible reasons for this unsatisfactory result is the subjectivity in assessing the symmetry and intensity of the sounds, especially considering that the examiners did not receive any clinical information before the examination. Also, about 15% of individuals with the disease had normal auscultation, perhaps representing the proportion of patients with pulmonary hyperinflation syndrome, which can occur without any abnormality in pulmonary auscultation.

The other evaluated aspect revealed that normal auscultation showed a sensitivity of 64% and PPV of only 17% to indicate that the other domains of the physical examination would result in normal findings, which indicates that the addition of new information obtained in the inspection, palpation and percussion is still probable, that is, if we do the complete physical examination we will identify new abnormalities, which could be the basis for the diagnosis of each disease. The capture of other information is especially important because the possibility of syndromic diagnosis results from the joint analysis of abnormalities in different areas of the exam, allowing the identification of a sufficient composition for the diagnosis of a pattern. The yield was slightly better when both auscultation and inspection were normal, especially in specificity, but this was also shown to be insufficient for the decision process.

Considering the finding of an abnormal pulmonary auscultation as a positive test, we found a relatively good sensitivity and PPV, 85% and 84% respectively, suggesting that auscultation when abnormal is efficient to detect disease, but the low specificity and NPV indicate that the reverse (normal auscultation) also occurs in a significant number of sick individuals, that is, as already mentioned, we were unable to exclude the presence of disease. On the other hand, an abnormal auscultation revealed a PPV of 81% to indicate that there would be some other abnormality in the other physical examination domains and, in the analysis of subgroups classified by physical examination domains, the PPV surpassed 90% for chest expansion, tactile fremitus or percussion abnormalities.

This logic favors the idea that the physical examination needs to continue, particularly when auscultation is normal. Analyzing subgroups, we observed different trends, as in the case of pulmonary consolidation, where the NPV was

relatively good, suggesting that auscultation is of greater importance in this situation. This makes sense, as we know that the different pleuropulmonary syndromes have their diagnostic basis in different domains of physical examination.

Thus, this study demonstrates that auscultation alone is an insufficient strategy for tracking diseases or establishing whether the continuity of the physical examination or complementary tests is necessary or not. If the goal is to enjoy the best possible performance through this tool, we still need to do a thorough physical examination of the chest, as we did 100 years ago. We must not forget that the rational use of complementary tests comes from our ability to generate the best hypotheses during patient care. It is possible that the reduction of time spent in consultations and the overuse of complementary tests are reducing the medical ability to perform and interpret the clinical examination and, as a vicious circle, further increasing the request for complementary tests and the cost of the health system.

5. Conclusion

Auscultation of the chest alone, may not be a sufficient strategy to track diseases or establish whether continuity of the examination is necessary or not.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Abbreviations

PHS, Pulmonary hyperinflation syndrome; ATE, atelectasis; CON, consolidation; PE, pleural effusion; Sn, sensitivity; Sp, specificity; NPV, negative predictive value; PPV, positive predictive value; PA, pulmonary auscultation; Abn, abnormal; ABS, Adventitious breath sounds; (+), present; (−), absent; VR, vocal resonance; CE, chest expansion; TF, tactile fremitus; SD, standard deviation.