

Diagnostic value of lung auscultation in an emergency room setting

Jörg D. Leuppi^{a,b*}, Thomas Dieterle^{c*}, Gian Koch^{a,d}, Benedict Martina^d, Michael Tamm^a, André P. Perruchoud^d, Irène Wildeisen^a, Bernd M. Leimenstoll^d

^a Pneumology, Department of Internal Medicine, University Hospital Basel, Switzerland

^b Basel Institute for Clinical Epidemiology, University Hospital Basel, Switzerland

^c Cardiology, Department of Internal Medicine, University Hospital Basel, Switzerland

^d Department of Internal Medicine, University Hospital Basel, Switzerland

Summary

Background: In daily routine, physicians use history, physical examination and technology-based information such as laboratory tests and imaging studies to diagnose the patients' disease. We determined the diagnostic value of lung auscultation in patients admitted to the Medical emergency room with chest symptoms.

Methods: Two-hundred-and forty-three consecutive patients (137 males), mean age 59.2 years were included. Internal Medicine registrars had to make a presumptive diagnosis, 1) after having taken the history and 2) after having auscultated the lungs. Thereafter, routine diagnostic procedures were performed. The estimated diagnosis was compared with the final diagnosis based on the written report to the Family Practitioner.

Results: Two-hundred-eighty-seven diagnoses were made. Eighteen percent of patients suffered from left heart failure, 13% from unexplained chest pain, 10.5% from chest wall pain, and 10.5% from pneumonia. Forty-one percent of the diagnoses were already correct when based only on the patient's history. Lung auscultation improved the

diagnostic yield only in 1% and worsened it in another 3%. By multiple logistic regression, normal lung auscultation (OR 0.12 [95CI% 0.053–0.29]) was the independent predictor for not having a lung or heart disease. However, elevation of B-type natriuretic peptide (BNP) (OR 1.16 per 100 pg/ml [95CI% 1.004–1.35]), wheezing (OR 0.023 [0.002–0.33]) and pCO₂ (OR 0.25 (0.10–0.62)) were independent predictors for having a heart disease, whereas wheezing (OR 7.41 [3.26–16.83]) and CRP (OR 1.008 per 10 units [1.003–1.014]) were risk factors for having a lung disease.

Conclusion: In contrast to history taking, abnormal lung auscultation does not appear to contribute considerably to the final diagnosis in patients presenting with chest symptoms in an emergency room setting. However, normal lung auscultation is a valuable predictor for not having a lung or heart disease, whereas wheezing is a predictor for having a lung disease and not having a heart disease.

Key words: medical history; lung auscultation

Background

Standard diagnostic procedures include history, physical examination, and technology-based information (e.g. laboratory tests, imaging studies etc. ...). In an out-patient setting, the predicted diagnosis after taking the history agreed with the final diagnosis two months after the initial visit in 82% of cases [1]. In a study by Peterson et al. [2], the final diagnosis was correctly estimated after the history was taken in 76%; whereas the physical examination led to the final diagnosis in only 12%, and the laboratory investigation in another 11%. The diagnostic value of lung auscultation in patients with chest symptoms has not been evaluated yet.

The stethoscope was introduced by the French physician Dr. Laennec [3]. Lung auscultation was acknowledged by a state of the art review a few years ago [4]. "Time-consuming" skills such as chest auscultation should be important filters for more diagnostic technology [5]. As a result, they have become the focus of recent attention since the advent of managed care and its renewed emphasis on more ambulatory and cost-effective medical care.

Under emergency room condition, there is a weak correlation between airway obstruction measured by spirometry and auscultation based estimation of airway obstruction [6]. In approxi-

* Jörg D. Leuppi and Thomas Dieterle contributed equally to the study and manuscript.

The study was financially supported by the AstraZeneca-Grant of the University Hospital Basel.

mately a third of these admitted patients, an airway obstruction was wrongly estimated by lung auscultation; thus, there is a real need and urge to perform spirometry.

There is some evidence that the auscultatory proficiency is not very good among Internal Med-

icine trainees [7]. We conducted a prospective study to evaluate the diagnostic value of lung auscultation determining the diagnoses in patients' admitted to the medical emergency ward with chest symptoms.

Methods

Study population and study design

Two-hundred and thirty-eight consecutive patients with chest symptoms presenting to the Medical Emergency Room of the University Hospital Basel were included during a six week period. Patients had to be older than 18 years of age, conscious and able to understand the study. All patients were interviewed and auscultated by Internal Medicine registrars before having access to relevant clinical information including laboratory investigations, chest X-ray, ECG, etc. The Internal Medicine registrars had to estimate the patient's final chest diagnosis after having read the referral letter from the patient's own physician and having taken the patients' history and, again after having auscultated the lungs. Thereafter, the patient's diagnostic work-up was based on the physicians' judgement including laboratory investigations, chest radiography or other imaging studies etc ... The estimated diagnoses before and after lung auscultation were compared with the final diagnoses based on the hospital-discharge letter to the General Physician. The investigators who read the hospital-discharge letter and defined the final diagnoses

were blinded to the estimated diagnoses of the Internal Medicine registrars.

The cut-off-point of being normal was seen at the level of <100 pg/ml for the B-type natriuretic peptide (BNP) [8], and <5 mg for the C-reactive protein (CRP) [9].

The study was approved by the Ethics Committee of Basel and the patients had to give a written informed consent.

Data analysis

Statistical analysis was performed with SPSS Version 11.0 for Windows. Differences between subgroups were assessed using one-way ANOVA. Factors that were significantly associated with having a heart or lung disease were identified in univariate logistic regression. To identify independent predictors for having a heart or lung disease, factors significantly associated with such a disease in univariate analysis were introduced in a multiple stepwise logistic regression. A p value <0.05 was considered to be statistically significant.

Results

Two-hundred-and forty-three consecutive patients were included in this study. There were 137 male patients (56.4%), and 72 patients (29.6%) were current smokers. The mean age was 59.2 years (range 18–93), and the mean BMI was 25.7 kg/m² (SD5). The Internal Medicine Registrars had a median of 2.5 years of training (range 1–7 years).

The patients' final diagnosis based on the medical records and the discharge letter to the family practitioners is shown in table 1. There were 287 diagnoses: one diagnosis was found in 181 patients, 2 diagnoses in 45 patients and more than 2 diagnoses in 5 patients. Eighteen percent of the patients suffered from left heart failure, 12.9% from unexplained chest pain, 10.5% from chest wall pain, 10.5% from pneumonia. In comparison to the final diagnoses, the estimated diagnoses after taking the history and after lung auscultation are shown in table 2. Forty-one percent of the final diagnoses were already made after taking the history, whereas correct diagnoses were made in 40% of the cases after lung auscultation. Lung auscultation improved the diagnosis in 1% (one patient with pneumonia and one patient with acute coronary disease) and worsened it in 2.8% (one patient with acute coronary syndrome and 2 patients with acute bronchitis/pneumonia). Lung auscultation

Table 1

Final diagnoses of patients admitted to the Medical Emergency Ward with chest symptoms.

	Diagnoses	%
Number of diagnoses	287	100
Left heart failure	52	18.1
Unexplained chest pain	37	12.9
Chest wall pain	30	10.5
Pneumonia	30	10.5
COPD	26	9.1
Coronary syndrome	22	7.6
Asthma	21	7.3
Smoke intoxication	12	4.2
Palpitation/hyperthyreosis	11	3.8
Pleuritis	10	3.5
Lung embolism	8	2.8
Gastroesophageal reflux	6	2.1
Hyperventilation	5	1.7
Acute bronchitis	5	1.7
Bronchiectasis	4	1.4
Pneumothorax	4	1.4
Cholelithiasis	3	1
Vaso-vagal reaction	2	0.7

187 patients had one diagnosis, 45 patients 2 diagnoses and 5 patients more than 2 diagnoses

did not change the diagnosis in 96.4% of the patients.

After adjusting for age, sex, smoking and body-mass-index (BMI), normal lung auscultation (OR 0.12 [95CI% 0.053–0.29]) was an independent predictor for not having a lung or heart disease. However, BNP (OR 1.16 per 100 pg/ml [95CI%

1.004–1.35]), wheezing (OR 0.023 [0.002–0.33]) and pCO₂ (OR 0.25 [0.10–0.621]) were independent predictors for having a heart disease, whereas wheezing (OR 7.41 [3.26–16.83]) and CRP (OR 1.008 per 10 units [1.003–1.014]) were risk factors for having a lung disease.

Table 2

Estimated diagnosis after history taking in comparison with the final diagnosis.

Final diagnosis	N	Correct diagnosis after history taking	Correct diagnosis after lung auscultation
Left heart failure	52	38 (73%)	35 (73%)
COPD/Asthma	47	38 (80.8%)	36 (76.6%)
Respiratory infectious diseases	49	22 (44.9%)	24 (49%)
Chest wall pain	30	1 (3.3%)	1 (3.3%)
Coronary syndrome	22	2 (9.1%)	3 (13.6%)
Smoke intoxication	12	12 (100%)	12 (100%)
Disease of the Intestine	9	1 (11.1%)	1 (11.1%)
Lung embolism	8	4 (50%)	4 (50%)
Other	58	1 (1.7%)	1 (1.7%)
Total	287	119 (41.6%)	117 (40.7%)

Respiratory infectious diseases: pneumonia, acute bronchitis, bronchiectasis; Diseases of the Intestine: gastro-oesophagal reflux disease, cholelithiasis

Discussion

The results of the present study suggest that under emergency room conditions, Internal Medicine Registrars estimate correctly the patient's chest disease in 40% of cases after taking the history. Lung auscultation hardly changes the estimated diagnosis; however, a normal lung auscultation is a predictor for not having a lung or heart disease, whereas wheezing in lung auscultation is a predictor for having a lung disease and also for not having a heart disease. Further, elevation of B-type natriuretic peptide (BNP) is an independent risk factor for having a heart disease.

After having read the referral letter from the Family physician and having taken the patients' history, the Internal Medicine Registrars diagnosed correctly in 40% of the cases. The usefulness and importance of the patient's history is not new. In a study by Hampton et al. [1], tdiagnoses agreed after taking the history in 66 out of 80 new out-patients (82.5%). Similar results were demonstrated by Peterson et al. [2] who found that taking the history led to the final diagnosis in 76% of out-patients. In a study with a "cardiological bias", 56% of the diagnoses were made from the history [10]. In comparison with these earlier studies, the correct estimation of the diagnosis after taking the history was overall lower in our study. However, there is quite a variation between diagnoses. Thus, chest diseases such as asthma or COPD were mainly correctly diagnosed after history taking; whereas chest wall pain had to be "worked-up" with further investigations and exclusion of other diseases. By using standardised patient cases, physicians seem to ask more than half of the essen-

tial history items; however, they may miss important patient information in their initial interactions with patients [11]. It has been further shown, that Internal Medicine training is associated with an increase in the perceived value of the medical history [12]. Our Internal Medicine Registrars had in average 3 years of training which might explain that difference. Therefore, we suggest that more time should be invested to improve the history-taking skills during clinical training.

To the best of our knowledge, this is the first study investigating the diagnostic value of lung auscultation under emergency room conditions. After lung auscultation, the estimated final diagnosis did not change in more than ninety percent of patients. However, lung auscultation improved the diagnosis in two patients with pneumonia and one with coronary heart disease, and worsened it in two patients with COPD and three patients with left heart failure. Overall, in patients with chest wall pain or coronary heart disease, lung auscultation did not contribute substantially to the final diagnosis. This might explain, at least in part, the low overall performance of lung auscultation in these patients. However, our findings are supported by former studies in which the diagnosis was also only improved in less than 12% of the patients after performing a physical examination [1, 2]. It has been also suggested that chest auscultation might account for one third of the errors in physical diagnoses [13]. There is some evidence that the auscultatory proficiency is not very well established among Internal Medicine trainees [7]. They seem to recognise less than half of all diag-

noses directly from patients' recorded respiratory events. Teaching of lung auscultation seems to be performed less often than cardiac auscultation [14]. Thus, there is a real need to improve the lung auscultation skills during clinical training. On the other hand, it really has to be noticed that lung auscultation contributes to final diagnosis in very few patients.

In our study, normal lung auscultation was an independent predictor for not having a lung or heart disease and wheezing in lung auscultation a clear predictor for having a lung disease and also for not having a heart disease. The value of lung auscultation has been quite controversially discussed in the literature: Based on an earlier French study [15], auscultatory breath sound intensity correlates quite well with impaired lung function; however, by using a histamine challenge test, tracheal sound patterns seem not to be proportionally related to lung function measurements [16]. By looking at "costs of unnecessary tests", Sandler et al. [10] found that taking the history was the most important factor in both diagnosis (56%) and management (46%) of different diseases; physical examination, however, was helpful in respiratory diseases, mainly in diagnosing chronic bronchitis and emphysema, and rather less useful in cardiovascular problems. Publications on evidence based physical examination have proposed to use decision trees to improve the diagnostic accuracy [17]. Our study represents the current status in an emergency room setting. Therefore, additional studies comparing evidence based decision trees with current practice would be useful. Physical examination including lung auscultation might have an important psychological effect on the patient-physician-relationship [18]. This issue should also be further investigated.

Elevation of BNP was an independent risk factor for having a heart disease, and CRP for having a lung disease. Several studies have now shown, that BNP correlates well with left heart failure, severity of its symptoms and prognosis [8, 19, 20].

BNP seem also to be useful for diagnosis and treatment of congestive heart failure [21]. There is evidence that BNP is helpful in the differential diagnosis of dyspnea [22, 23]: In severe dyspneic patients with normal left ventricular systolic function, BNP levels were higher in patients with diastolic heart failure than those with obstructive lung disease. Therefore, BNP might be very useful in excluding left heart failure in patients which could suffer from both left heart failure and COPD. C-reactive protein has been shown to be an important and sensitive marker of infections in many clinical situations, including COPD exacerbations, although it does not seem to be necessarily a marker of bacterial infection per se [24]. However, we do not think that it should be recommended to measure BNP and CRP uncritical in all patients presenting with chest symptoms; the use of these biochemical markers should still be based on the pretest probability.

In conclusion, medical history taking remains the cornerstone of diagnosis in patients presenting with chest symptoms in an emergency room setting. Abnormal lung auscultation does not appear to contribute considerably to the final diagnosis in these patients. However, normal lung auscultation is a valuable predictor for not having lung or heart disease, whereas wheezing is a predictor for having a lung disease and not having a heart disease.

We would like to thank Ms Desirée Gassmann and Ms Margrith Knecht for helping with the data collection.

Correspondence:

Jörg D. Leuppi, MD PhD

Pneumology

University Hospital

Petersgraben 4

CH-4031 Basel

Switzerland

E-Mail: jleuppi@ubbs.ch

References

- Hampton JR, Harrison MJ, Mitchell JR, Prichard JS, Seymour C. Relative contributions of history-taking, physical examination, and laboratory investigation to diagnosis and management of medical outpatients. *Br Med J* 1975;2:486-9.
- Peterson MC, Holbrook JH, Von Hales D, Smith NL, Staker LV. Contributions of the history, physical examination, and laboratory investigation in making medical diagnoses. *West J Med* 1992;156:163-5.
- Sakula A. RTH Laennec 1781-1826: His life and work: a bicentenary appreciation. *Thorax* 1981;36:81-90.
- Pasterkamp H, Kraman SS, Wodicka GR. Respiratory sounds: advances beyond the stethoscope. *Am J Respir Crit Care Med* 1997;156:974-87.
- Bettencourt PE, Del Bono EA, Spiegelman D, Hertzmark E, Murphy RLH. Clinical utility of chest auscultation in common pulmonary diseases. *Am J Respir Crit Care Med* 1994;150:1291-7.
- Leuppi JD, Dieterle T, Wildeisen I, Martina B, Tamm M, Koch G, et al. Can airway obstruction be estimated by lung auscultation in an emergency room setting? *Resp Med*. 2005. In press.
- Mangione S, Nieman LZ. Pulmonary auscultatory skills during training in Internal Medicine and Family Practice. *Am J Respir Crit Care Med* 1999;159:1119-24.
- Maisel AS, Krishnaswamy P, Nowak RM, McCord J, Hollander JE, Duc P, et al. Rapid measurement of B-type natriuretic peptide in the emergency diagnosis of heart failure. *N Engl J Med* 2002;347:161-7.
- Christ-Crain M, Jaccard-Stolz D, Bingisser R, Gencay MM, Huber PR, Tamm M, et al. Effect of procalcitonin-guided treatment on antibiotic use and outcome in lower respiratory tract infections: cluster-randomised, single-blinded intervention trial. *Lancet* 2004;363:600-7.
- Sandler G. Costs of unnecessary tests. *Br Med J* 1979;2:21-4.

- 11 Ramsey PG, Curtis JR, Paauw DS, Carline JD, Wenrich MD. History-taking and preventive medicine skills among primary care physicians: an assessment using standardized patients. *Am J Med* 1998;104:152–8.
- 12 Rich EC, Crowson TW, Harris IB. The diagnostic value of the medical history. Perceptions of internal medicine physicians. *Arch Intern Med* 1987;147:1957–60.
- 13 Wray NP, Friedland JA. Detection and correction of house staff error in physical diagnosis. *JAMA* 1983;249:1035–7.
- 14 Mangione S, Duffy FD. The teaching of chest auscultation during primary care training: has anything changed in the 1990s? *Chest* 2003;124:1430–6.
- 15 Bohadana AB, Peslin R, Uffholtz H. Breath sounds in the clinical assessment of airflow obstruction. *Thorax* 1978;33:345–51.
- 16 Rietveld S, Dooijes EH, Rijssenbeek-Nouwens LH, Smit F, Prins PJ, Kolk AM, et al. Characteristics of wheeze during histamine-induced airways obstruction in children with asthma. *Thorax* 1994;50:143–8.
- 17 Froelicher V, Shetler K, Ashley E. Better decisions through science: exercise testing scores. *Prog Cardiovasc Dis* 2002;44:395–414.
- 18 Eide H, Graugaard P, Holgersen K, Finset A. Physician communication in different phases of a consultation at an oncology outpatient clinic related to patient satisfaction. *Patient Educ Couns* 2003;51:259–66.
- 19 Lubien E, DeMaria A, Krishnaswamy P, Clopton P, Koon J, Kazanegra R, et al. Utility of B-natriuretic peptide in detecting diastolic dysfunction: comparison with Doppler velocity recordings. *Circulation* 2002;105:595–601.
- 20 Krishnaswamy P, Lubien E, Clopton P, Koon J, Kazanegra R, Wanner E, et al. Utility of B-natriuretic peptide levels in identifying patients with left ventricular systolic or diastolic dysfunction. *Am J Med* 2001;111(2):274–9.
- 21 Kuster GM, Tanner H, Printzen G, Suter TM, Mohacsi P, Hess OM. B-type natriuretic peptide for diagnosis and treatment of congestive heart failure. *Swiss Med Wkly* 2002;132:623–8.
- 22 Cabanes L, Richaud-Thiriez B, Fulla Y, Heloire F, Vuilleumard C, Weber S, et al. Brain natriuretic peptide blood levels in the differential diagnosis of dyspnea. *Chest* 2001;120:2047–50.
- 23 Mueller C, Scholer A, Laule-Kilian K, Martina B, Schindler C, Buser P, et al. Use of B-type natriuretic peptide in the evaluation and management of acute dyspnea. *N Engl J Med* 2004;350:647–54.
- 24 Dev D, Wallace E, Sankaran R, Cunniffe J, Govan JR, Wathen CG, et al. Value of C-reactive protein measurements in exacerbations of chronic obstructive pulmonary disease. *Respir Med* 1998;92:664–7.

The many reasons why you should choose SMW to publish your research

What Swiss Medical Weekly has to offer:

- SMW's impact factor has been steadily rising, to the current 1.537
- Open access to the publication via the Internet, therefore wide audience and impact
- Rapid listing in Medline
- LinkOut-button from PubMed with link to the full text website <http://www.smw.ch> (direct link from each SMW record in PubMed)
- No-nonsense submission – you submit a single copy of your manuscript by e-mail attachment
- Peer review based on a broad spectrum of international academic referees
- Assistance of our professional statistician for every article with statistical analyses
- Fast peer review, by e-mail exchange with the referees
- Prompt decisions based on weekly conferences of the Editorial Board
- Prompt notification on the status of your manuscript by e-mail
- Professional English copy editing
- No page charges and attractive colour offprints at no extra cost

Editorial Board

Prof. Jean-Michel Dayer, Geneva
 Prof. Peter Gehr, Berne
 Prof. André P. Perruchoud, Basel
 Prof. Andreas Schaffner, Zurich
 (Editor in chief)
 Prof. Werner Straub, Berne
 Prof. Ludwig von Segesser, Lausanne

International Advisory Committee

Prof. K. E. Juhani Airaksinen, Turku, Finland
 Prof. Anthony Bayes de Luna, Barcelona, Spain
 Prof. Hubert E. Blum, Freiburg, Germany
 Prof. Walter E. Haefeli, Heidelberg, Germany
 Prof. Nino Kuenzli, Los Angeles, USA
 Prof. René Lutter, Amsterdam, The Netherlands
 Prof. Claude Martin, Marseille, France
 Prof. Josef Patsch, Innsbruck, Austria
 Prof. Luigi Tavazzi, Pavia, Italy

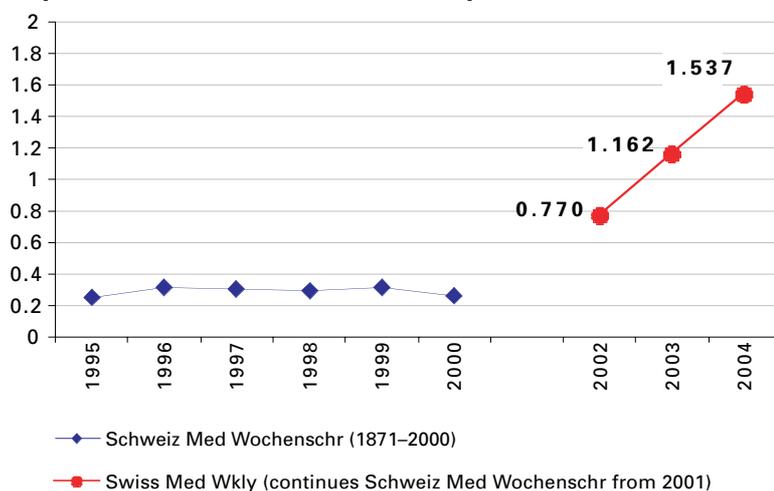
We evaluate manuscripts of broad clinical interest from all specialities, including experimental medicine and clinical investigation.

We look forward to receiving your paper!

Guidelines for authors:

http://www.smw.ch/set_authors.html

Impact factor Swiss Medical Weekly



All manuscripts should be sent in electronic form, to:

EMH Swiss Medical Publishers Ltd.
 SMW Editorial Secretariat
 Farnsburgerstrasse 8
 CH-4132 Muttenz

Manuscripts: submission@smw.ch
 Letters to the editor: letters@smw.ch
 Editorial Board: red@smw.ch
 Internet: <http://www.smw.ch>