Lung Function and Quality of Life in Workers with Chemical and Dust Exposure

MARINA RUXANDRA OTELEA[1], OANA CRISTINA ARGHIR[2]*, CORINA ZUGRAVU[3], EUGENIA NAGHI[4], SABINA ANTONIU[5], AGRIPINA RASCU[4]

[1] Carol Davila University of Medicine and Pharmacy, 2nd Clinical Department, 1 Dr Grozovici Str., 02115, Bucharest, Romania

[2] Ovidius University of Constanta, Faculty of Medicine, 4th Department of Clinical Diseases, Clinical Pneumophthisiology Hospital, 40 Sentinelei Str., 900002, Constanta, Romania

[3] Carol Davila University of Medicine and Pharmacy, Department of Fundamental Sciences, National Institute of Public Health, 1-3, Dr Leonte Anastasievici Str. , 050463, Bucharest, Romania

[4] Carol Davila University of Medicine and Pharmacy, 5th Clinical Department, Occupational Medicine Clinic, Colentina Hospital, 19-21, Stefan cel Mare Str., 020125, Bucharest, Romania

[5] University of Medicine and Pharmacy Grigore T. Popa, 2nd Department of Medicine, Nursing/Palliative Care, 16 Universitatii Str., 700337, Iasi, Romania

Regarding the widely distribution of respiratory exposure hazards in occupational settings, workers have an increased risk for chronic lung diseases. For assessing the quality of life and lung function in workers exposed to chemicals and dust, St George's Respiratory Questionnaire (SGRQ) and spirometry were performed among 40 patients, admitted in Occupational Clinic Department of Colentina Hospital, Bucharest, Romania, during February, 2017. SGRQ showed different predictors for patients according to their occupational exposure and total symptoms score correlated better with decreased spirometric parameters in defining lung function deterioration. Quality of life is earlier affected than lung function deterioration and emphasises the need of more sensitive methods for an earlier identification and better evaluation of respiratory hazards in different workplaces.

Keywords: chemical and dust exposure, quality of life, occupational lung diseases

Both particulate and chemical air pollution remain high topics on the public agenda [1]. Despite successful measures to reduce respiratory exposure implemented in Europe, industrial air pollution remains an important matter of concern for both environmental scientists and medical professionals. A recent employment survey, conducted in Germany, showed that 16% percentage of men and 9% of women were exposed to respiratory exposure hazards [2]. Romanian studies revealed occupational exposure to dust, chemical or other biological hazards which are present in various workplaces, having different consequences on health [3-5]. The mixture of the chemical compounds varies in different industrial workplaces; for example, foundry workers with silicosis are exposed to numerous volatile compounds: furan, phenol-formaldehyde, resins, ammonia, benzene, toluene, sulphuric acid mixt, metals beside silica, and dust exposure to silicates is not only limited to industrial settings, but is also present in urban environment [6]. Occupational asthma has either allergic or irritant mechanism [7], but even though, a mixed exposure is frequent: textile dust is allergenic, but the indoor air pollution in textile industry involves, beside the textile dust, a large number of chemicals such as dyes, solvents, halogen based bleaching agents, finishing agents, flame retardants or endotoxins [8]. Workers can be exposed to coal tar pitch volatiles and polycyclic aromatic hydrocarbons, fluorides, alumina and calcined coke dusts, sulphur dioxide and carbon monoxide, and the most frequently diagnosed form of irritant induced asthma, in Romania, is potroom asthma [9]. As lungs offer a large surface of contact, occupational and environmental chemical hazards are better absorbed into the circulation and can lead to acute or chronic poisonings, precipitating acute cardio-vascular events, inducing cancers, especially lung cancer in non-smokers [10], or autoimmune diseases [11, 12]. Therefore, beside recent exposure effects, which are far from being standardized in Europe [13], respiratory diseases and disorders continue to be the leading cause of disability related to occupation, and the evaluation of the medium and long term effect of respiratory poisonings on lung function decline are gaining, also, importance [14]. Spirometry is the most currently used test in occupational medicine for all respiratory exposure hazards [15]. Reduction in lung function directly impairs lung function and quality of life [16-19].The quality of life of these patients could be significantly modified before any sign of obstructive or restrictive pattern is recorded by this method [19].

Therefore, the aim of study was to assess if quality of life of workers exposed to respiratory hazards is earlier affected than lung function deterioration.

Experimental part

A cross-sectional study was performed among 40 patients admitted in the Occupational Medicine Clinic of Colentina Hospital, Bucharest, Romania, during 01 – 28 February 2017. Inclusion criteria consisted in respiratory occupational disease, previously diagnosed in workers with past chemical and dust exposure. Subjects were recruited in order of their hospital admittance and then divided into 2 subgroups: obstructive lung disease determined by chemical exposure and pneumoconiosis related to silica or asbestos exposure. Lung function was evaluated among subgroups by spirometry, performed with Jager/Viasys Pneumotachograph, following standard technique procedures. Registered data were reported to the

* email: arghir_oana@yahoo.com

international reference values and interpretation of the pulmonary function test (PFT) was done according to international recommendations [15]. Data base analysis included predicted values (%) of the vital capacity (VC), forced expiratory flow in 1 second (FEF_1), and maximal expiratory flow at 50% of VC (MEF_{50}), respectively. Health related quality of life was assessed using Saint George's Respiratory Questionnaire (SGRQ) translated in Romanian and respiratory, activity, impact and total scores were calculated by validated methodology referring to already declared normal values [14,16,20]. Data were processed by STAT PLUS MacPro v6 software, using Pearson correlation and regression and ANOVA for variables comparing. Threshold was set at 95% probability level.

Results and discussions

The mean age of 40 inpatients was 53 years, with no significant differences between men and women, or according to the different diagnosis subgroups: 23 cases with obstructive lung disease (OLD) and 17 with pneumoconiosis (P) related to silica or asbestos occupational exposure. In P subgroup, women were almost 2 times more (64.7%) than in OLD subgroup (34.78%). Lung function investigation revealed normal values of parameters (n=18) versus mild (n=11), moderate (n=4) and severe reduction (n=7) of lung function, according to current guidelines [12], presenting statistical significant differences (pÂ 0.005) between parameters of lung function (VC, FEF_1) among cases by gender (men versus women), SQRS symptom score by gender and SQRS activity and total score by lung disease (P versus OLD) (table 1 and 2). Correlation analysis of health-related quality of life scores and different lung function parameters among all cases (P and OLD) revealed negative relationships (table 3, figs. 1-4). Correlations between VC, FEF_1, FEF_1/VC and MEF_{50} and SGRQ total score were, also, assessed, by occupational exposure, among patients of subgroups:

- P subgroup with significant negative R for VC (R= -0.60, p=0.01), FEF_1 (R= -0.64, p=0.005) and MEF_{50} (R= -0.51, p=0.03), and
- OLD group with significant Spearman correlation for FEF_1/VC (R= -048, p=0.02) and MEF_{50} (R= -053, p=0.009).

St George's Respiratory Questionnaire has been selected because in all occupational respiratory disorders and diseases, particularly those generated by industrial settings, there is, in various proportions, a mixed respiratory exposure to bronchial chemical irritants and inorganic particles contained in dust. The best linear regression model for SGRQ total score was predicted by the ratio FEF_1/CV among all cases (P+OLD) with better FEF_1 pattern in P subgroup and MEF_{50} in OLDs. Patients coming from textile

Cases	VC (%) Mean	FEF1 (%) Mean	FEF1/CV (%) Mean	MEF50 (%) Mean
All	85.07	80.21	90.63	59.9
Men	78.2*	73.35*	88.83	53.1
Women	91.15*	86.35*	91.75	66.8
Type of lung disease				
Pneumoconiosis	78.82	80.19	94.89	59.99
Obstructive lung disease	84.63	80.22	87.47	59.83

Table 1
PARAMETERS OF LUNG FUNCTION EVALUTION BY SPIROMETRY

*Legend: VC = vital capacity; FEV_1 = forced expiratory flow in 1 second MEF_{50} = maximal expiratory flow at 50% of VC; % of predicted value;*p < 0.005*

Cases	Symptom score *Mean*	Activity score *Mean*	Impact score *Mean*	Total score *Mean*
All	61.35	56.15	36.98	155.2
Men	72.15*	57.3	34.5	164.8
Women	50.55*	55	39,45	145.6
Type of lung disease				
Pneumoconiosis	54,67	37.56*	40.84	133.07*
Obstructive lung disease	66.93	70.54*	34.9	172.37*

Table 2
SAINT GEORGE QUESTIONNAIRE SCORES

*Legend: VC = vital capacity; FEV_1 = forced expiratory flow in 1 second MEF_{50} = maximal expiratory flow at 50% of VC; % of predicted value; *p < 0.005*

SGRQ scores	CV (%)	FEF1 (%)	FEF1/CV (%)	MEF (%)
Symptoms score	-0.31*	-0.37*	-0.35*	-0.43*
Activity score	-0.18	-0.27	-0.52*	-0.36*
Impact score	-0.22	-0.25	-0.02	-0.13
Total score	-0.33*	-0.42*	-0.48*	-0.47*

Table 3
CORRELATION COEFFICIENTS BETWEEN HEALTH-RELATED QUALITY OF LIFE SCORES AND LUNG FUNCTION PARAMETERS

*Legend: VC = vital capacity; FEV_1 = forced expiratory flow in 1 second; MEF_{50} = maximal expiratory flow at 50% of VC; % of predicted value; *p < 0.005*

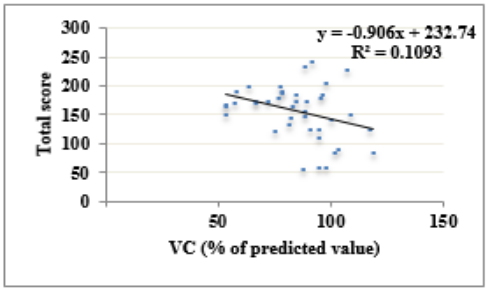

Fig 1. Relationship between St George total score and vital capacity in cases (n=40)

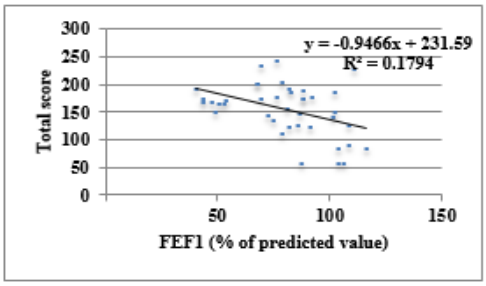

Fig 2. Relationship between St George total score and FEF_1 in cases (n=40)

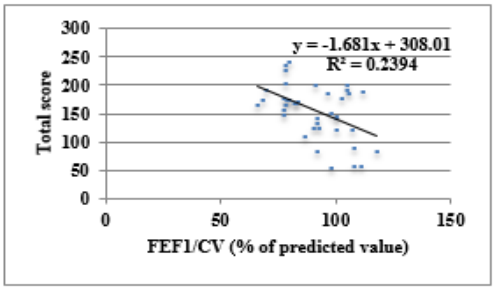

Fig 3. Relationship between St George total score and FEF_1/VC in cases (n=40)

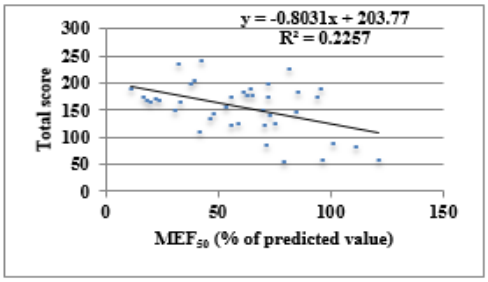

Fig 4. Relationship between St George total score and MEF_{50} in cases (n=40)

industry were exposed to the textile dust, but also to dyes, chemical solvents, finishing agents. In the potroom workers, occupational exposure to chemical substances and inorganic mineral particles (polycyclic aromatic hydrocarbons, fluorides, sulphur dioxide and carbon monoxide, alumina, calcined coke dusts) was similar to previously data reported in such work settings [7]. So, we consider, STRQ might be a reliable tool for the health-related quality of life assessment of exposure to mixture of respirable dust particles and chemical substances. The results of our study confirm the relationship between the STRQ total score and the deterioration of the lung function. In the same time, there were differences according to the past occupational exposure and the pattern of lung involvement (pneumoconiosis versus OLD) similar with observations noticed in patients with interstitial lung disease versus COPD [19] when adjusted to the reduction of FEF_1. The high score of respiratory symptoms is explained by the fact that previously occupational exposure induced different occupational diseases (P or OLD). The activity score, assessed during hospitalization, had higher values, especially, in patients with OLD (asthma or COPD) admitted for severe exacerbations versus patients with pneumoconiosis. The deterioration of lung function occurs later than quality of life. As mentioned, foundry workers with silicosis are exposed to numerous volatile compounds beside silica and, therefore, they cumulate pneumoconiosis risk factors for chronic bronchitis, COPD and, even, lung cancer outcomes [21,22]. Asbestos exposure, associated with cement exposure and irritants in the construction industry, is still a major concern in Romania [23,24]. The most interesting finding of our study was the impact score. All cases (n=40) had significantly higher scores than normal values, but the lower and the higher quartile had no significant differences regarding lung function impairment (p=0.15). Occupational exposure is, generally, considered higher and constant than environmental exposure [25] of general population; therefore more health effects are noticed. The environmental impact of certain occupational exposure should be estimated based on the World Health Organization definition of health and fruitfully work [26,27] and, for this purpose, screening of lung function by spirometry is not quite the most adequate method, because it does not relates with the impact score of SGRQ, even in exposed workers, already diagnosed with lung diseases. Our study null hypothesis started from the fact that spirometry is a reliable test for measuring the influence of respiratory exposure hazards on the quality of life and it could be proposed as an assessment tool of environmental health impact. Strictly for the evolution course of occupational lung diseases, as recorded in the symptoms and activity score, lung function measurement, by spirometry, offers very good correlation. Reducing exposure to air pollutants is an important objective of a healthier environment [28]. Regarding the problems of Romanian health system and the role of crisis on people×s health [29], the impact of social and psychological status on the quality of life is a complex resultant of many other factors, even economics, and the influence of lung function becomes diluted inside the influence of these factors.

Conclusions

Our data support the hypothesis that quality of life might be earlier affected than lung function deterioration and emphasises the need of more sensitive methods in evaluating the impact of chemical respiratory hazards on general population.

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