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RESPIRATORY FUNCTION IN CHRONIC PRIMARY FIBROMYALGIA

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ABSTRACT. Since patients with severe chronic primary fibromyalgia (CPF) report effort dyspnoea, respiratory function was studied in 87 consecutive women with CPF according to Yunus' criteria. Bernstein spirometry, maximum inspiratory (MIP) and expiratory (MEP) pressures were obtained in patients, and in a reference group of 61 healthy women. MIP was considerably lower in patients than in controls (3.6 ± 2.0 vs. 8.0 ± 2.2 kPa, $p < 0.0001$), as was MEP (3.1 ± 2.1 vs. 8.3 ± 2.2 kPa, $p < 0.0001$). Patients who had previously reported dyspnoea at a bicycle exercise test showed significantly lower values of respiratory pressures than patients without dyspnoea. Respiratory pressures were reproducibly low in CPF patients. Spirometric values were normal among patients and controls. We conclude that maximum expiratory and inspiratory pressures are low in CPF, a finding which may indicate respiratory muscle dysfunction in this syndrome.

Key words: chronic primary fibromyalgia (CPF), dyspnoea, respiration, respiratory pressures, spirometry.

Patients, mainly females, with chronic muscle pain of unknown etiology form an increasing problem to the medical health care system. The symptoms are often referred to as the Chronic Primary Fibromyalgia (CPF) syndrome (19). The pain in this syndrome is often localized to the paravertebral muscles of the cervical and lumbar spine and the extremities but often also to the intercostal and abdominal muscles and the costovertebral junctions. Besides the pain, complains of muscular fatigue and weakness are common, and morphologic changes verify muscular disease (10). Many patients regard their overall physical performance as reduced when compared to before onset of the symptoms. We have observed that dyspnoea is a prevalent symptom among patients with CPF, and that this symptom is associated with low physical performance on bicycle ergometer test (8). These findings raised the hypothesis that patients with CPF have impaired ventilatory function or respiratory muscle dysfunction. We have therefore made a controlled study of pulmonary function and maximum respiratory pressures in patients with CPF.

MATERIAL AND METHODS

We studied 87 consecutive female patients, who fulfilled the criteria of CPF (8, 19), and were admitted to our rehabilitation clinic for vocational guidance and pain treatment. The patients were admitted mainly from orthopaedic surgeons but also from rheumatologists and general practitioners. Secondary fibromyalgia, as well as other musculoskeletal, neuromuscular and neurological disease were excluded by routine clinical examination and medical history. Inflammatory rheumatic disease was excluded by laboratory tests. Pulmonary disease was excluded by medical history and physical examination.

The patients, 42 immigrants and 45 Swedes, were all blue-collar workers. They were on sick leave or on early retirement since at least 12 months. The pain symptoms indicative of CPF were of long duration (mean 3.5 years, range 2–11 years).

As a control group we selected 61 healthy Swedish women, mainly hospital staff, without symptoms from muscles, joints or respiratory tract. Despite an effort to recruit age matched controls they were somewhat younger than patients ($p < 0.001$), Table I. Patients were significantly shorter ($p < 0.001$) and heavier ($p < 0.001$) than controls, while smoking habits did not differ significantly.

All subjects passed pulmonary function tests including measurement of vital capacity (VC), forced expiratory volume during one second (FEV_1) and maximum inspiratory and expiratory pressures (MIP, MEP). VC and FEV_1 were recorded by means of a water-sealed Bernstein spirometer. Three acceptable recordings were obtained from each manoeuvre and the highest values were used for further analysis. The values were expressed as percentage of the predicted normal values according to Berglund et al. (5). The maximum respiratory pressures were obtained at ordinary end-expiration (functional residual capacity (FRC) level) with the subjects seated breathing in a mouth-piece connected to a three-way valve. A pressure-port close to the mouth-piece was connected to a pressure transducer, in turn connected to an ink-jet recorder (Elema Schönander). The experienced technician observed the subject who was breathing quietly. At FRC level the valve was closed and the subject was encouraged to inspire or exspire as forcefully as possible. The unidirectional effort to breath was maintained during approximately three seconds and the pressure was recorded. A small

Table I. *Physical characteristics and smoking habits. Values are mean (range)*

	Physical characteristics			Smoking habits (%)		
	Age (years)	Height (cm)	Weight (kg)	Non-smokers	Ex-smokers	Active smokers
Patients ($n=87$)	43.9 (26–65)	163.3 (146–176)	68.2 (46–115)	46.9	12.3	40.7
Controls ($n=61$)	36.8 (19–62)	167.0 (153–181)	61.8 (49–79)	47.5	26.2	26.2

leakage (negligible volume not influencing pressures) prevented erroneous recordings which might arise from usage of chin muscles and glottis closure. The maximum pressure being maintained for at least one second was taken as the maximum pressure of that recording, as illustrated for MIP in Fig. 1 (9). This procedure was repeated until five recordings were obtained for MIP and MEP respectively. The highest value was used in the further analysis.

In order to test the reliability of the measurements, 10 patients and 32 controls repeated the measurements of respiratory pressures twice, with a time elapse of five months (0.25–11) between the test situations.

We recorded CO_2 response-curves according to Read et al. (17) in 12 patients chosen at random as well as in 12 controls in order to estimate the chemical drive on ventilation.

In 84 patients electromyogram (EMG) was recorded from the trapezoid muscle at that side of the body where the most severe pain was perceived. Myopathy was defined as abnormally short duration (according to age dependent reference value) and polyphasic EMG potentials. At graded bicycle exercise test the perception of dyspnoea was repeatedly questioned and noted (6, 8). Patients were subgrouped into those who experienced dyspnoea during the exercise test and those who did not. Ventilatory function of both groups was compared.

Statistics

The hypothesis of no difference between mean values was tested with two-sided Student's *t*-test. *p*-Values <0.05 were considered statistically significant. To test the reproducibility of maximum respiratory pressures Pearson's correlation coefficient, intraindividual variance, and variation coefficient were computed for a subsample subjected to a second measurement.

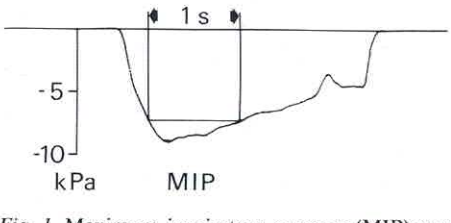

Fig. 1. Maximum inspiratory pressure (MIP) was measured as the lowest pressure which was held during 1 s.

RESULTS

Maximum inspiratory and expiratory pressures were low and significantly reduced compared to the controls (3.6 ± 2.0 vs. 8.0 ± 2.2 kPa, $p<0.0001$; and 3.1 ± 2.1 vs. 8.3 ± 2.2 kPa, $p<0.0001$). There was no correlation between respiratory pressures and age, height or weight in the control group. Mean respiratory pressures of the control group were therefore used as predicted normal values without adjustments. Maximum respiratory pressures as well as VC and FEV_1 are shown in relation to predicted normal values in Fig. 2. VC and FEV_1 of both groups were normal according to the reference values which we use for clinical investigations (5). VC and FEV_1 among controls were slightly higher than among the patients.

Almost two thirds (61 %) of the patients perceived dyspnoea during a bicycle exercise test. They were compared to non-dyspnoeic patients (39 %) as regards spirometric data and maximum respiratory pressures. Maximum respiratory pressures were lower in the dyspnoeic group ($p<0.05$), while VC and FEV_1 did not differ, Fig. 3.

Within the patient group, MIP ($p<0.002$) and MEP ($p<0.0001$) were lower among the immigrants. VC and FEV_1 did not differ between Swedes and immigrants. Dyspnoea as a reason for interruption of the bicycle exercise test was equally distributed among Swedes and immigrants.

Reproducibility results are given in Table II. There was no significant difference between the first and second measurement in any group.

In 45/84 patients myopathy of the trapezoid muscle was present as judged by EMG. No correlation was observed between the presence of myopathy and VC, FEV_1, respiratory pressures or dyspnoea.

CO_2 ventilatory drive (patients 12.0 ± 4.5, range 4.8–20.4 vs. in controls 13.9 ± 4.8, range 5.7–19.7

Table II. *Repeated measurement (I and II) of maximal respiratory pressures in a subsample of 32 healthy women and 10 women with CPF*

	Measurement (mean ± SD)		Correlation	Intraindividual variance	Variation coefficient
	I (kPa)	II (kPa)	*r*	(kPa)	(%)
Maximum expiratory pressure					
Patients	2.2±1.0	2.3±1.8	0.32	1.16	52
Controls	7.2±2.3	7.9±2.5	0.62	1.53	20
All	6.1±3.0	6.7±3.3	0.80	1.45	23
Maximum inspiratory pressure					
Patients	2.9±1.6	3.0±1.2	0.72	0.74	25
Controls	7.8±2.2	8.0±1.9	0.69	1.17	15
All	6.7±3.1	6.9±2.7	0.85	1.09	16

l min^{-1} kPa^{-1}, not significant) was within normal limits (17) for all examined patients.

DISCUSSION

Only female patients were included in the present study because the male prevalence of CPF is low and inclusion of a few males would have complicated the evaluation of the results. Medical history and clinical findings were similar in all the patients. However, they are not representative of all patients with CPF as only the most severe cases, where treatment had been unsuccessful, were referred to the rehabilitation clinic. All patients fulfilled the criteria of CPF of suggested by Yunus (19). Other neurological, orthopaedic or rheumatological diseases were excluded as far as possible by routine clinical procedures. None of the patients had respiratory disease. As a study group, therefore, they seemed homogeneous.

Patients with CPF often have several symptoms in common with neurocirculatory asthenia (16), such as chest pain, vegetative symptoms, and dyspnoea. Since some symptoms of CPF, such as hallucinations and severe neurasthenia may indicate a psychiatric disorder, such an etiology of the CPF syndrome has been suggested (11), but seems less likely (1). Psychologic factors are necessarily involved in a multisymptomatic disease centered around aches and pain, but a

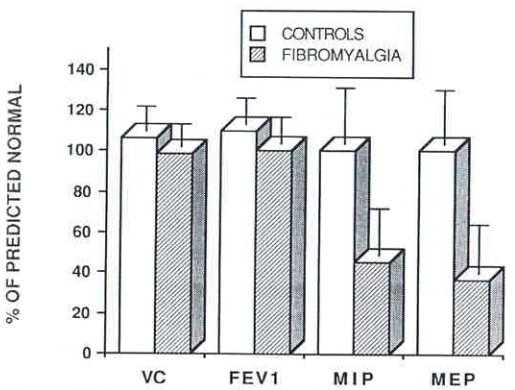

Fig. 2. Vital capacity (VC), and forced expiratory volume during 1 s (FEV_1) were slightly higher in the control group (both $p<0.05$) despite normal findings in patients according to our reference values (5). Maximum inspiratory (MIP) and expiratory (MEP) pressures in the 87 women with chronic primary fibromyalgia (CPF) were, however, markedly lower than in the control group of 61 healthy women (both $p<0.001$).

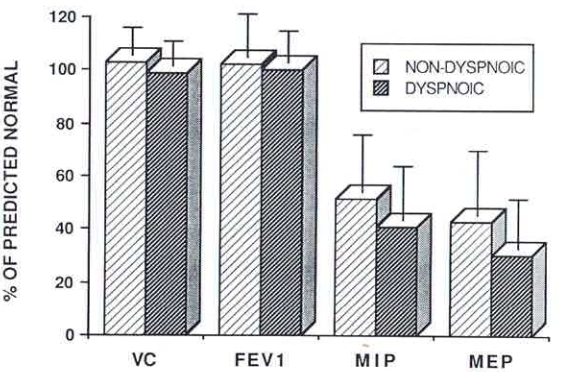

Fig. 3. Those of the CPF patients who reported dyspnoea during an exercise stress test ($n=46$) were compared to those who did not ($n=31$). All values are expressed as % of predicted normal. VC and FEV_1 did not differ between the groups, while MIP and MEP were slightly lower (both $p<0.05$) in the dyspnoeic group. Abbreviations as in Fig. 2.

possible influence on the investigation from such factors could hardly explain the rather homogeneous pattern of low respiratory pressures in the presence of normal VC and FEV_1. The similar reproducibility of the measurements between patients and controls makes it also unlikely that mental factors were of major importance.

The intraindividual variances for MEP and MIP were similar in patients and controls, while the variation coefficient was high in patients due to low mean values in this group. This means that the method will not separate between patients but between patients and controls. We found normal values of VC and FEV_1 among the CPF women, indicating normal dynamic (i.e. shortening of muscle fibres) capacity of their respiratory muscles. On the other hand their maximum respiratory pressures were low as compared to those found in healthy women, a finding indicating low isometric (i.e. no appreciable shortening of muscle fibres) capacity of their respiratory muscles. This is in accordance with the observation by Jacobsen & Danneskiold-Samsoe (12) that particularly isometric muscular capacity is lowered in CPF patients. Furthermore, it is in line with observations from work-situations where the patients often find static loads to increase the pain, exhaustion and subjective swelling of their muscles. Presence of muscular involvement in the CPF syndrome seems fairly convincing from EMG findings of myopathy in the present study, and microscopic (13) as well as biochemical (2, 3, 14) evidence of muscular abnormalities. It was recently shown that handgrip strength is reduced in CPF patients, as is muscular relaxation rate (7).

It has been observed that patients with CPF show signs compatible with dysfunction at the brain stem level (4, 15, 18). The dyspnoea observed among patients with CPF could therefore be the result of a disturbed function of the respiratory centre in the brain stem. We evaluated this possibility by CO_2-stimulation of the central drive on the respiratory muscles. However, the CO_2 response-curve was normal in 12 randomly chosen patients. Thus, a dysfunction of the chemical drive at the brain stem level cannot explain the inefficiency of the respiratory muscles. Despite this, central nervous processing may, together with respiratory muscle dysfunction, explain the dyspnoea noted.

It is concluded that CPF patients seem to have an isometric type of dysfunction of their respiratory muscles, since respiratory pressures were reproducibly low despite normal spirometry and an apparently normal chemical drive to breathe.

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