Regular physical activity preserves the lung function in patients with ankylosing spondylitis without previous lung alterations

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ABSTRACT

Ankylosing spondylitis is an inflammatory condition which causes restriction in the lung function due to column joint alterations leading to postural dysfunction and thoracic ciphosis. ***Objective:*** *The objective of this study was to evaluate the lung function in patients with ankylosing spondylitis and to associate this parameter with physical activity.* ***Methods:*** *104 patients were selected and only 15 fulfilled inclusion and exclusion criteria. They were divided in two groups: group I composed by sedentary patients, and group II with patients that has a regular physical activity. Demographic features, parameters of cervical, dorsal and lumbar column mobility were collected. Measurements of minute volume, respiratory rate, maximum inspiratory and expiratory pressures and quality of life (HAQ-S) were also evaluated.* ***Results:*** *Both groups were similar regarding mean age (49.6 ± 1.6 vs. 43.3 ± 13.2 years, p = 0.19), weight (70.9 ± 9.7 vs. 74.1 ± 12.1 kg, p = 0.30) and height (164.6 ± 3.5 vs. 167.6 ± 6.9 cm, p = 0.16). However, the mean disease duration was significantly higher in the group I compared to the active group (20.1 ± 6.9 vs. 9.6 ± 3.4 years, p = 0.004). Interestingly, a significantly higher minute volume was observed in the active group than inactive one (4.83 ± 1.07 vs. 6.1 ± 1.25 L/min, p = 0.035). On the other hand, no differences were found regarding respiratory rate (14.57 ± 1.76 vs. 16.25 ± 3.53 ipm, p = 0.15), tidal volume (0.402 ± 0.07 vs. 0.342 ± 0.10 L, p = 0.13), as well as maximum inspiratory pressure (84.29 ± 24.99 vs. 93.13 ± 16.76 cmH_2O), p = 0.24) and maximum expiratory pressure (102.2 ± 29.26 vs. 105 ± 17.32 cmH_2O, p = 0.42).),* ***Conclusion:*** *This study seems to show that respiratory volumes are maintained stable in patients with ankylosing spondylitis that are under regular physical activity.*

Keywords: *ankylosing spondylitis, spondyloarthropathy, lung function, physical training, physical activity.*

INTRODUCTION

Ankylosing spondylitis (AS) is a progressive chronic inflammatory disease, with unknown etiology that affects, especially, sacroiliac joints and spine leading to loss of mobility.[1] The pulmonary function tests in AS have revealed a high prevalence of restrictive defect, characterized by a low forced vital capacity. Rigidity of the thorax occurs in AS with bony ankylosis of the thoracic vertebrae, costovertebral, costotransverse, sternoclavicular and sternomanubrial joints leading to a predominant diaphragmatic breathing.[2,3]

The importance of studying the respiratory system in these patients is related to the necessity of a minimum of respiratory capacity suitable for performing daily activities.[3-5]

Considering that there is no definitive treatment for AS and the main goals are to educate and make patient aware of his/her participation in an exercise program so that he/she can keep a functional posture and also maintain movements, this research is a transversal study aiming at comparing patients with AS and verifying the effect of moderate regular physical activity in these patients' respiratory capacity.[4-8]

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PATIENTS AND METHODS

Patients: From August to November, 2001, 104 patients with ankylosing spondylitis that had been followed up at the *Seronegative* Spondyloarthropathy Unit at the Rheumatology Department of Hospital das Clínicas of University of São Paulo Medical School (FMUSP) were selected for this protocol accordingly to *New York* [9] criteria.

Inclusion criteria were: Patients diagnosed by international criteria of ankylosing spondylitis[9] whose ages were equal or higher than 18 years old who had this disease for more than five years. Additionally, patients who have been practicing on a regular basis any type of physical training (running, swimming, cycling or treadmill) at least twice a week and for a minimum of thirty minutes were included.

Exclusion criteria were other conditions that could influence pulmonary function tests, such as: Previous history or physical examination suggesting cardiac or pulmonary diseases, smoking habits, congenital kyphoscoliosis, history of previous thoracotomy; or even patients with other associated seronegative arthropathy.

Materials: All patients underwent a through physical examination: *p*ulmonary auscultation, respiratory rate, expansibility and chest symmetry through physical exam.[10] Each patient signed an informed consent and answered a protocol of functional capacity – HAQ modified for ankylosing spondylitis (HAQ-S), from 0 to 3 (0 for total independence and 3 for severe functional disability), and a specific protocol for possible respiratory changes.[11]

In order to measure positive and negative maximum pulmonary pressure, a "Ger-Ar" brand compound gauge was used to evaluate respiratory muscle strength, as there is a change in lung function due to chest movement limitation resulting from thorax and spinal rigidity, and it cannot be evaluated by spirometry. In order to get minute volume and tidal volume, an "Ohmeda" respirometer was used. A 3-cm long and 1-cm width adapted mouthpiece was connected to both devices in order to avoid air escaping from the patient's mouth.[12,13]

Clinical assessments: The following tests were performed: chest expansion, finger-to-floor distance, occipital wall distance and Schober test using measuring tape.[14]

The chest expansion was measured around, during maximum inspiration and maximum expiration, and the difference between these two measures (cm) was recorded. Normal values were those higher or equal to 2.5cm of difference. Finger-to-floor distance measures were also taken, considering the distance of the third finger to the floor (cm).[14]

Occipital wall distance measure was taken with patient's heels leaning on the wall and the body straight without bending the knees (cm). Normal value is zero, that is, occipital should touch the wall. For Schober's test, posterior superior iliac spines are palpated and a line between them is delineated. With the individual standing with straight body, a measure 10 cm over this line is marked. Ask the patient to lean the body forward and measure the distance between these two points (cm). Normal values were those whose distance between these two points were higher or equal to 5 cm.[15]

Each measure was taken three times without interruption and then an average was calculated.

Minute volume (MV) is the volume of air which can be inhaled or exhaled from a person's lungs in one minute (L/min). This measure was taken asking the patient to breathe in and out normally for one minute. This device read the average of all expirations during this minute (MV= TVx RR).[16]

Tidal volume (TV) is the lung volume representing the normal volume of air displaced between normal inhalation and exhalation when extra effort is not applied (~ 500 mL) and it is obtained dividing by the number of breaths the patient take in this minute, which is the respiratory rate (TV= MV/ RR).[16]

Maximum inspiration pressure was obtained requesting a maximum inspiration started from the deepest expiration, that is, from a residual volume. The unit is cmH2O; maximum expiration pressure was measured from a deep inspiration, that is, the volume of air contained in the lungs at the end of maximum inspiration, total lung capacity.[16]

In statistical analysis, *t*-test was used to compare both groups. When $p < 0.05$, it was considered significant.

RESULTS

Out of 104 patients selected, only 15 could take part of this study according to exclusion criteria. Many of them were smokers, cardiac disease patients, pneumopathy patients or presented associate arthropathies. These 15 patients were divided into two groups: Sedentary group (I) (n = 8) and active group (II) (n = 7), consisting of regular physical training practitioners.

Patient's group I (sedentary) and group II (active) were similar regarding mean age (49.6 ± 11.6 *versus* 43.3 ± 13.2 years, respectively, $p = 0.19$). These groups were also similar regarding anthropometric variables, such as weight (70.9 ± 9.7 *versus* 74.1 ± 12.1 years, $p = 0.30$) and height (164.6 ± 3.5 *versus* 167.6 ± 6.9 cm, $p = 0.16$). However, the mean disease duration was significantly higher in group I compared to the active group (20.1 ± 6.9 *versus* 9.6 ± 3.4, $p = 0.004$) (Table 1).

Table 1
Demographic and anthropometric characteristics of two groups of patients with ankylosing spondylitis

	Group I (sedentary)	Group II (active)	*p*
Mean age (years)	49.6 ± 11.6	43.3 ± 13.2	0.19
Disease duration (years)	20.1 ± 6.9	9.6 ± 3.4	0.004*
Weight (kg)	70.9 ± 9.7	74.1 ± 12.1	0.30
Height (cm)	164.6 ± 3.5	167.6 ± 6.9	0.16

Table 2
Results of clinical assesments and HAQ in two groups of ankylosing spondylitis patients

	Group I (sedentary)	Group II (active)	*p*
Schober (cm)	3.0 ± 1.79	2.38 ± 1.56	0.23
Middle finger-to-floor distance (cm)	31.23 ± 11.2	27.13 ± 8.21	0.23
Occipital wall distance (cm)	8.36 ± 7.38	8.88 ± 7.46	0.45
Chest expansion (cm)	2.36 ± 1.06	3.19 ± 1.32	0.12
HAQ (*Health Assessment Questionnaire*)	0.96 ± 0.45	1.05 ± 0.51	0.37

Table 3
Results of pulmonary mechanical measures in two groups of ankylosing spondylitis patients

	Group I (sedentary)	Group II (active)	*p*
RR(ipm)	14.57 ± 1.76	16.25 ± 3.53	0.15
TV (L)	0.402 ± 0.07	0.342 ± 0.10	0.13
MV (L/min)	4.83 ± 1.07	6.1 ± 1.25	0.035*
Pi Max (cmH_2O)	84.29 ± 24.99	93.13 ± 16.76	0.24
Pe Max (cmH_2O)	102.2 ± 29.26	105 ± 17.32	0.42

RR: respiratory rate; TV: tidal volume; MV: minute volume; Pi Max: maximum inspiration pressure; Pe Max: maximum expiration pressure

Regarding variables related to disease damage in axial skeleton, both groups did not present significant differences in none of the studied variables. The Schober's test (3.0 ± 1.79 *versus* 2.38 ± 1.56 cm, $p = 0.23$), middle finger-to-floor distance (31.23 ± 11.2 *versus* 27.13 ± 8.21 cm, $p = 0.23$), occipital wall distance (8.36 ± 7.38 *versus* 8.88 ± 7.46 cm, $p = 0.45$), and, finally, chest expansion (2.36 ± 1.06 *versus* 3.19 ± 1.32, $p = 0.12$) were comparable in both groups, respectively (Table 2). Functional capacity, measured by HAQ-S, was also similar in both groups: 0.96 ± 0.45 *versus* 1.05 ± 0.51, respectively, $p = 0.37$ (Table 2).

Concerning the scope of this paper, pulmonary mechanical measures, the active patient group presented, significantly, a higher minute volume when compared to the sedentary group (4.83 ± 1.07 *versus* 6.1 ± 1.25, $p = 0.035$). On the other hand, no differences were found regarding respiratory rate (14.57 ± 1.76 *versus* 16.25 ± 3.53 ipm, $p = 0.15$), tidal volume (0.402 ± 0.07 *versus* 0.342 ± 0.10 years, $p = 0.13$), as well as maximum inspiratory pressure (84.29 ± 24.99 *versus* 93.13 ± 16.76 cmH_2O, $p = 0.24$) and maximum expiratory pressure (102.2 ± 29.26 *versus* 105 ± 17.32 cmH_2O, $p = 0.42$) (Table 3).

In the protocol about possible signals of respiratory changes, 43.88% of the patients presented fatigue at medium efforts, and 21.9% at large efforts. Coughing was observed in 27.7% and dyspnea in 21.7% of the total patients studied (data not shown in tables).

DISCUSSION

The results showed that patients with ankylosing spondylitis who practice some regular physical activity present a preservation of their pulmonary function, measured by minute volume.[14]

Choosing patients who practiced such physical exercises was based on the study by Seçkin *et al.*,[16] Santos *et al.*[15] and Carbon *et al.*,[12] which concluded that these exercises are moderate and ideal for AS patients, because they maintain or improve quality of life, without influencing disease's activity. Maintenance findings on the quality of life in this paper reinforce these previous studies, although they are not significant.

In this paper, with exception of recent prosthesis, presence of prosthesis was not an exclusion criteria, in the beginning of the trial seven patients had prosthesis (one in the shoulder and six in the hip) and it was not a limiting factor for physical training, different from literature and existing studies. However, only one patient with prosthesis took part of this study, as the other patients were excluded due to new prostheses.

Strict exclusion criteria were used in this study, leading to an analysis of a homogeneous population and without higher external interference of cardiopulmonary function. We also highlight the exclusion of patients with smoking habits, because, according to Averns *et al.*,[7] as smokers patients presented a clinical aggravation, both functional and radiological, and cigarette effects increase morbidity and mortality rates in these patients.

Disease duration is one of the factors that may influence the level of physical involvement of these patients. The longer the pathology extension, more restrictions are observed concerning mobility and functional capacity. According to Ward *et al.*,[18] this factor is one of the main causes that increment the incapacity at work and, then, disability retirement. This factor may be a determinant factor of the best performance of active individuals in their current job. However, there was no statistically significant difference in clinical and functional parameters (Schober's test, finger-to-floor distance and occipital wall distance, chest expansion and HAQ) among the groups, reducing the relevance of the factor of disease duration in the findings of this study.

Band *et al.*[11] discuss that the age influences upon the treatment and conclude in their study that younger patients, women and those with shorter disease duration tend to respond better to physical therapy. In this study, there was no this confusing factor, because both groups presented similar ages.

Carbon *et al.*[12] and Uhrin *et al.*[17] demonstrated that physical training promotes a beneficial effect in flexibility and wideness of spinal movement due to release of analgesic and anti-inflammatory effect mediators. Additionally, Uhrin *et al.*[17] discussed in their paper that daily exercises without supervision did not show any relation with changes in pain, stiffness or quality of life, as we also demonstrated here in these two last variables.

Regarding the pulmonary mechanics, minute volume is statistically related to physical activity, that is, even with mechanical change established by this disease and generating chest rigidity, the volume of air that passes through airways every minute is better maintained in individuals who had practiced physical activity regularly.

Inspiration and expiration pressures were within normal limits, and they were not able to identify the group of patients with regular physical activity from sedentary patients. This finding is in accordance with the literature where AS is a restrictive pathology; therefore, changes in maximum expiration pressure are not expected.[10]

Hence, it was concluded that regular physical activity in ankylosing spondylitis patients allows maintenance of respiratory capacities and volumes, regardless low thoracic expansibility and spinal mobility restriction. Additionally, physical training provides a general welfare, keeping individual's functional capacity.

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