Balance and falls in axial spondyloarthritis: a cross-sectional study

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ABSTRACT

Background: Spondyloarthritis (SpA) patients may suffer from balance loss predisposing them to falls.
We aim to study balance impairment and falls in axial SpA patients and its association with clinical and epidemiological variables, disease activity, functional and metrology indexes.
Methods: Cross-sectional study of 55 SpA patients with axial disease. Clinical and epidemiological data were collected from the charts. Balance was accessed by Berg Balance Scale (BBS). The following instruments were applied: ASDAS (Ankylosing Spondylitis Disease Activity Score)-ESR, ASDAS-CRP, BASDAI (Bath Ankylosing Spondylitis Disease Activity Index), BASFI (Bath Ankylosing Spondylitis Functional Index), BASMI (Bath Ankylosing Spondylitis Metrology Index) and ASQoL (Ankylosing spondylitis quality of life questionnaire). The number of falls in the last year was obtained through direct questioning.
Results: In this sample, 30.9% had high risk of falls by the BBS and 25.4% recalled having at least one fall in the last years. The BBS values were lower in those with white ethnic background (p=0.01), smokers (p=0.03) and with HLA-B27 (p=0.03) and correlated inversely with BASDAI (rho=-0.28), ASDAS-ESR (rho=-0.32) and ASDAS-CRP (rho=-0.33), BASFI (rho=-0.71,p<0.0001), BASMI (rho=-0.80; p<0.0001), ASQoL (rho=-0.57; p<0.001) and age (rho=-0.50;p<0.001). Linear multivariable analysis showed that BASFI and BASMI were independently associated with BBS (p=0.01 and <0.0001 respectively). Patients with falls had lower BBS (p=0.03) and loss of balance correlated with impairment of the quality of life (rho=-0.56; p<0.001).
Conclusions: Balance is impaired in 1/3 of axial SpA patients and the BBS is associated mainly with functional and metrology indexes, showing that patients with severe cumulative damage are more affected.

Keywords: Spondyloarthritis; Balance; Falls.

INTRODUCTION

Spondyloarthritis (SpA) patients, mainly those with advanced disease, may have postural difficulties[1]. In these patients the spine may became stiff due to the chronic inflammatory process of fibroconnective tissues and bones, leading to hip flexion, increase in dorsal kyphosis and loss of lumbar and cervical lordosis. Knee flexion occurs as a compensatory mechanism promoting the appearance of the classic skier posture. Such malalignment causes dislocation of the center of mass of the trunk, disturbing static and dynamic balance[2]. It also causes difficulties in looking up and creating visual inputs that are important to compensate the negative effects of postural instability[3]. Balance in SpA may be further conditioned by impairment of sensory pathways, vestibular dysfunction and by inflammation of tendons[4-6]. According to Demontis *et al.*[4], stimulation of muscle and tendons by the inflammatory process may alter the sensitivity of muscle spindles leading to decrease in proprioceptive perceptiveness and contributing to the problem.

Balance impairment is a frequent and underdiagnosed manifestation in SpA that may contribute to the loss of life's quality[4]. These patients may also have comorbidities such as osteoporosis[7]. The combination of postural instability increasing the chance of falls[8] and osteoporosis[7], heightens the risk of fractures further aggravating the deterioration of life's quality. In terms of morbidity and mortality, injurious falls have serious consequences of which the hip fracture is the most feared one[9]. SpA patients, when falling, may harm themselves more easily than normal individuals because their spine is inflexible, disturbing the capacity

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to protect themselves after sudden changes of position[10]. However, Aydog *et al*[10] studying 75 patients with ankylosing spondylitis failed to prove that these patients have more balance disorders when compared to controls[10].

In this study we aimed to analyze the presence of balance impairment in axial SpA patients and to verify the influence of epidemiological and clinical factors that are associated with its appearance.

METHODS

This was a cross-sectional study approved by the local Committee of Ethics in Research. All participants signed consent. It included a convenience sample of 55 axial SpA patients that came for regular consultations in a single center, for the period of one year and that agreed to participate in the study. To be included patients had to fulfill the classification criteria for axial SpA according to Assessment of Spondyloarthritis International Society (ASAS)[11].

Epidemiological (gender, age, disease duration, ethnic background, smoking habits, work status), clinical (peripheral arthritis, dactilitis, enthesitis, ocular involvement, presence of HLA-B27), and treatment data was obtained through chart review. Clinical data were considered in a cumulative way. Information on image [presence of sacroiliitis unilateral or bilateral judged by magnetic resonance imaging (MRI)] was provided by the attending rheumatologist and followed the definition of ASAS/Omeract MRI group[12].

The number of falls in the last year was obtained through the question: "How many falls did you have in last year?"

Bath Ankylosing Spondylitis Disease Activity Index (BASDAI)[13], Ankylosing Spondylitis Disease Activity Score) -ESR (erythrocyte sedimentation rate)[14] and ASDAS-CRP (C reactive protein)[14], Bath Ankylosing Spondylitis Functional Index (BASFI)[15], and Bath Ankylosing Spondylitis Metrology Index (BASMI)[16]; Ankylosing spondylitis quality of life questionnaire (ASQoL)[16] were obtained. Simultaneously the Berg Balance scale (BBS)[17] was applied. The BBS has 14 tasks that assesses the patient's ability to either keep balance statically, or while performing movements for a specified duration of time. Each item scores from 0 to 4, with a maximum global score of 56 points. Values ≤ 45 indicate that individuals may be at greater risk of falling and score of < 40 are associated with almost 100% fall risk[18].

Data was collected in frequency and contingency tables. The Shapiro-Wilk test was used to study data distribution. BBS values were studied as a continuous variable. To compare BBS values according to clinical, epidemiological, image and treatment variables, the Mann Whitney test was applied. Correlation studies were done by Spearman test. The adopted significance was of 5%. A linear multiple regression was performed in a backward stepwise using BBS values as a continuous dependent variable to investigate the best subset of variables in which the best fit in the model. The software Medcalc 10.0 was used to perform calculations.

RESULTS

The main characteristics of the studied sample is on Table I.

In this sample, the BBS ranged from 35.0 to 56.0 (median of 51.0 with IQR= 44.0-55.0). In 38/55 (69.0%) the BBS values were >45 and in 17/55 (30.9%) were ≤ 45. About 25.4% (14/55) patients remembered having at least one fall in the last year.

The comparison of BBS according to clinical, image findings and treatment data is shown on Table II. There it is possible to see that, patients with white ethnic background, exposure to tobacco and history of falls in the last year, had lower values of BBS.

Table III shows the correlation studies of BBS with age, disease duration and result of applied instruments. This table shows that all studied variables but disease duration had a negative correlation with BBS values.

Linear multivariable analysis showed that BASFI (with p=0.01; Beta coefficient=-0.05) and BASMI (p<0.0001; Beta coefficient= -1.35) were independently associated with BBS values.

DISCUSSION

The present results show that almost 1/3 of the studied axial SpA patients may be at greater risk of falling as they have a BBS under 45. Indeed, almost 1/4 of them did fall in the year prior to the study. The multivariable analysis showed that the functional and the metrology indexes are the variables related independently with balance loss; both of them reflect SpA structural damage.

Exposure to tobacco, the presence of HLA-B27 and white ethnic background were associated with lower BBS in univariate analysis. A systematic literature re-

TABLE I. MAIN EPIDEMIOLOGICAL, CLINICAL AND TREATMENT DATA OF 55 PATIENTS WITH AXIAL SPONDYLOARTHRITIS

Male sex (n-%)	39/55 - 70.9%
Age (years) (mean+/- SD)	47.8±11.0
Auto declared ethnic background (n-%)	
White	41/55 - 74.6%
Non-white	14/55 - 25.4%
Work incapacity (n-%)	
None	22/54 - 40.7%
Partial	9 /54 - 16.6 %
Total	23/54 - 42.5%
Exposure to tobacco (ex and current smokers) (n-%)	28/55 - 50.9%
Median disease duration (years) (IQR)	9.0 (5.0-13.0)
Clinical data	
Bilateral sacroiliitis on MRI (n-%)	47/55 - 85.4%
Unilateral sacroiliitis on MRI (n-%)	8/55 - 14.5%
Non radiographic SpA (n-%)	2/55 - 3.6%
Peripheral arthritis (n-%)	8/55 - 14.5%
Dactilitis (n-%)	5/55 - 9.0%
Enthesitis (n-%)	34/55 - 61.8 %
Uveitis (n-%)	17/55 - 30.9%
HLA-B27 (n-%)	37/51 - 72.5%
Treatment Data	
Non-steroidal anti-inflammatory drugs users (n-%)	50/55 - 90.9%
Methotrexate users (n-%)	5/55 - 11.1%
Anti TNF-α drugs users (n-%)	30/55 - 54.5%
Applied instruments	
BASDAI - Median (IQR)	3.4 (2.0-5.4)
ASDAS-ESR - Median (IQR)	2.4 (1.9-3.3)
ASDAS-CRP - Median (IQR)	2.7 (2.1-3.6)
BASMI - Median (IQR)	4.0 (3.0-7.0)
BASFI - Median (IQR)	4.0 (1.7-6.9)
ASQoL - Median (IQR)	6.0 (4.0-11.0)

N: number; IQR: interquartile range; SD: Standard deviation; BASDAI: Bath Ankylosing Spondylitis Disease Activity Index; ASDAS: Ankylosing Spondylitis Disease Activity Score; ESR: erythrocyte sedimentation rate; CRP: C reactive protein; BASMI: Bath Ankylosing Spondylitis Metrology Index; BASFI: Bath Ankylosing Spondylitis Functional Index; ASQol: Ankylosing Spondylitis Quality of Life questionnaire.

view by Villaverde-García *et al.*[19] showed that smoking has a dose-dependent impact in progression of structural damage in axial SpA that could lead to worse balance and explain our findings. The negative impact of smoking may be caused by increased systemic inflammation; accelerated radiographic progression has also been observed in this context[20]. In addition, smokers have poorer treatment adherence and worse response to anti TNF drugs when compared with never smokers[20].

Worse balance was found in HLA-B27 positive and white patients. Caucasians are known to have higher prevalence of HLA-B27 in their SpA population than non-Caucasians[21] and this gene, although associated with the development of SpA, cannot be linked to increased structural damage[22] that is supposed to be the subjacent reason for the balance impairment. In fact, a study by Jamalyaria *et al.*[23] found that the non-white population with ankylosing spondylitis have more disease activity, greater functional loss and worse disease prognosis when compared to whites or Latinos.

Another finding of the present study was the asso-

TABLE II. STUDY OF BBS (BALANCE BERG SCALE) VALUES ACCORDING TO EPIDEMIOLOGICAL, CLINICAL AND TREATMENT VARIABLES

Variable	Median BBS with the variable (IQR)	Median BBS without the variable (IQR)	P(*)
Male gender	51 (44.0-55.0)	51.0 (44.2-53.7)	0.80
White ethnic background	49.0 (42.5-53.0)	54.0 (30.2-55.0)	0.01
Exposed to tobacco (ex and current)	46.0 (41.5-54.0)	52.0 (46.5-55.0)	0.03
Bilateral sacroiliitis	51.0 (45.0-55.0)	53.5 (46.2-55.0)	0.63
Enthesitis	50.0 (38.5-55.2)	51.0 (44.5-55.0)	0.45
Dactilitis	50.5 (42.0-54.2)	51.0 (44.0-55.0)	0.73
Uveitis	51.0 (46.5-55.0)	50.5 (41.7-55.0)	0.26
Peripheral arthritis	52.0 (40.7-55.7)	51.0 (33.0-54.0)	0.92
HLA-B27 presence	52.0 (44.5-55.0)	48.5 (39.5-51.1)	0.03
Anti TNF-α users	50.5 (45.0-54.7)	52.0 (39.0-55.0)	0.67
History of falls in the last year	46.5(40.0-50.2)	52.0 (44.5-55.0)	0.03

IQR: interquartile range.
(*) P refers to the comparison of BBS values in patients with and without the variable described in the first column.

TABLE III. CORRELATION STUDIES OF BBS (BERG BALANCE SCALE) VALUES WITH AGE, DISEASE DURATION, DISEASE ACTIVITY INDEXES, FUNCTIONAL AND METROLOGY INDEXES AND QUALITY OF LIFE

	Rho	95% confidence interval	P
BASDAI	-0.28	-0,51 to -0,008	0.03
ASDAS ESR	-0.32	-0,54 to -0,05	0.01
ASDAS CRP	-0.33	-0.55 to -0.06	0.01
BASFI	-0.71	-0.82 to -0.55	<0.0001
BASMI	-0.80	-0.88 to -0.67	<0.0001
ASQoL	-0.56	-0.72 to -0.35	<0.0001
Age (years)	-0.50	-0.68 to -0.25	<0.0001
Disease duration (years)	-0.10	-0.36 to 0.17	0.44

BASDAI: Bath Ankylosing Spondylitis Disease Activity Index; ASDAS: Ankylosing Spondylitis Disease Activity Score; ESR: erythrocyte sedimentation rate; CRP: C reactive protein; BASMI: Bath Ankylosing Spondylitis Metrology Index; BASFI: Bath Ankylosing Spondylitis Functional Index; ASQol: Ankylosing Spondylitis Quality of Life questionnaire.

ciation of disease activity with loss of balance. The link between disease activity with structural damage has been highlighted by a 12-year longitudinal study by Ramiro *et al.*[24] that showed that sustained increased disease activity may lead to new bone formation and radiographic progression mainly in the early phases of the disease. In the present, the three instruments used to measure disease activity correlated with balance loss although only in the univariate analysis, suggesting that the structural damage they originate are causing the problem. So, treating inflammation vigorously may be a strategy to avoid future loss of balance.

Balance is defined as postural adaptation to changes in the gravity center at rest and activity keeping it within the base of support with minimal postural sway[25]. It requires a precise coordination of visual, auditory, proprioceptive, neuromuscular and central nervous system and it is necessary to accomplish daily activities that are important to keep ones' independence[25]. Studies by Bot *et al.*[26] revealed that the thoracic kyphosis, seen in advanced disease, causes a forward and downward displacement of the spine weight center. In order to maintain balance, compensatory movements in the lower extremities occur such as hip extension, knee

flexion and ankle plantar flexion. Arthritis and enthesitis in the lower extremity joints may affect this adaptation[25]. Others noted that increased pelvic tilt (the angle formed by the line passing from the head of the femur and the line connecting the middle of the sacral plateau) and decreased pelvic incidence (the angle between the perpendicular line drawn to the sacral endplate and the line connecting the midpoint of the sacral plateau and hip axis) affect balance[27]. All the abovementioned alterations are seen in patients with advanced disease and offer an explanation for our results that showed association of loss of balance in those with worse BASFI and BASMI.

This study has limitations: it includes a small sample of patients and it has a transversal design. The number of falls were determinate by patients' recollection and may suffer recall bias. Nevertheless, it does highlight the problem of loss of balance in SpA patients and the need to prevent functional loss in order to avoid this problem. Rehabilitation treatment, including postural and proprioceptive exercises, seems effective on helping balance control[4] and should be included in the treatment of these patients.

Summarizing, the present study shows that SpA patients may have important loss of balance that is associated independently with loss of function and mobility.

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