Risk of Falls in Patients With Ankylosing Spondylitis

Nigar Dursun, MD, Selda Sarıkaya, MD,† Senay Ozdolap, MD,† Erbil Dursun, MD,* Coskun Zateri, MD,‡ Lale Altan, MD,§ Murat Birtane, MD,‖ Kenan Akgun, MD,¶ Aylin Revzani, MD,# İlknur Aktas, MD,** Nurettin Tastekin, MD,‖ and Reyhan Celiker, MD††*

Background: Risk of vertebral fractures is increased in patients with ankylosing spondylitis (AS). The underlying mechanisms for the elevated fracture risk might be associated with bone and fall-related risks. The aims of this study were to evaluate the risk of falls and to determine the factors that increase the risk of falls in AS patients.

Methods: Eighty-nine women, 217 men, a total of 306 AS patients with a mean age of 40.1 ± 11.5 years from 9 different centers in Turkey were included in the study. Patients were questioned regarding history of falls within the last 1 year. Their demographics, disease characteristics including Bath AS Disease Activity Index, Bath AS Metrology Index (BASMI), Bath AS Functional Index (BASFI), and risk factors for falls were recorded. The Short Physical Performance Battery (SPPB) test was used for evaluation of static and dynamic balance. Erythrocyte sedimentation rate, C-reactive protein, and 25-hydroxyvitamin D levels were measured.

Results: Forty of 306 patients reported at least 1 fall in the recent 1 year. The patients with history of falls had higher mean age and longer disease duration than did nonfallers (P = 0.001). In addition, these patients' BASMI and BASFI values were higher than those of nonfallers (P = 0.002; P = 0.000, respectively). We found that the patients with history of falls had lower SPPB scores (P = 0.000). We also found that the number of falls increased with longer disease duration and older age (R = 0.117 [P = 0.041] and R = 0.160 [P = 0.005]). Our results show that decreased SPPB scores were associated with increased number of falls (R = 0.183, P = 0.006). Statistically significant correlations were found between number of falls and AS-related lost job (R = 0.140, P = 0.014), fear of falling (R = 0.316, P = 0.000), hip involvement (R = 0.112, P = 0.05), BASMI (R =0.234, P = 0.000), and BASFI (R = 0.244, P = 0.000).

Conclusions: Assessment of pain, stiffness, fatigue, and lower-extremity involvement as well as asking for a history of falls will highlight those at high risk for further falls. In addition to the general exercise program adopted for all patients, we suggest that a balance rehabilitation program should be valuable for the patients with risk factors for fall. Exercise may improve fear of falling and BASFI and BASMI scores. However, further study is needed to investigate these hypotheses. We believe that clinicians should train and support the patients via reducing fear of falls and maintaining good posture and functional capacity.

Key Words: ankylosing spondylitis, fall, SPPB, BASMI, balance

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Ankylosing spondylitis (AS) is a chronic inflammatory disease that starts with inflammation in the sacroiliac joint and enthesis sites of the spine and results in formation of new bone and ankylosis. The disease also affects the root joints, such as the shoulder and hip, and leads to the reduction in mobility and restriction of daily living activities. In AS patients, vertebral ankylosis leads to hyperkyphosis. Hip extension, knee flexion, and ankle plantar flexion attempt to balance the forward displacement of the center of body mass in the sagittal plane.[1–3] But as the disease progresses, these attempts become inadequate, and loss of balance is inevitable.[4] With the increased risk of falling, fractures in the rigid spine develop more easily. Cooper et al reported that the relative risk of morphometric vertebral fractures in AS was 7.6.[5] The major neurological complication rate associated with fractures is high, and cervical-level injuries are seen more frequently.[6–9] In patients with AS, the bad image quality of spine radiograph and long-existing chronic pain make it difficult to diagnose fractures, and this leads to higher neurological complication rates.[5,9]

Although there are studies on evaluating balance in patients with AS in the literature, there are only 2 studies that investigated the factors that affect the risk of falls in these patients.[10,11] In these studies, posture and balance of the patients were evaluated, and the findings were compared with healthy individuals. Several studies[12–14] assessed balance and posture by using different devices, yet there are no studies that use a fall-risk screening test or to assess functional performance. Considering the postural and biomechanical changes throughout the natural course of AS both bone and fall-related risks might be associated with fractures. Even very simple falls or minor traumas may result in fractures, and no clear data are available on the risk of falls for this patient population. Although it is thought that AS patients have increased risk of falls, there is no consensus on clinical indicators or tests that could be used in the assessment of these risks. The aims of this study were to evaluate the risk of falls and to determine the factors that increase the risk of falls in AS patients. In addition to that, a simple clinical test, Short Physical Performance Battery (SPPB), was assessed to see if it is useful for this evaluation.

MATERIALS AND METHODS

Twelve investigators from 9 centers located in 6 provinces participated in the study. These investigators are members of the Activity Platform created in 2009, which is a scientific group studying on rheumatic diseases. The patients who were diagnosed with AS based on the modified New York criteria[15] followed up by members of the Activity Platform were included in the study. The demographic data of patients (age, disease duration, morning stiffness, job loss due to disease, sick leave due to disease) were recorded. Erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) levels were measured.

From the *Department of Physical Medicine and Rehabilitation, Kocaeli University Faculty of Medicine, Kocaeli; †Department of Physical Medicine and Rehabilitation, Bulent Ecevit University Faculty of Medicine, Zonguldak; ‡Department of Physical Medicine and Rehabilitation, Çanakkale Onsekiz Mart University Faculty of Medicine, Çanakkale; §Department of Physical Medicine and Rehabilitation, Uludag University Faculty of Medicine, Bursa; ‖Department of Physical Medicine and Rehabilitation, Trakya University Faculty of Medicine, Edirne; and ¶Department of Physical Medicine and Rehabilitation, Istanbul University Cerrahpaşa Faculty of Medicine; #Department of Physical Medicine and Rehabilitation, Bezmialem University Faculty of Medicine; **Physical Medicine and Rehabilitation Clinic, Fatih Sultan Mehmet Teaching and Research Hospital; and ††Department of Physical Medicine and Rehabilitation, Acibadem University Faculty of Medicine, Istanbul, Turkey.

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The authors declare no conflict of interest.

Correspondence: Selda Sarıkaya, MD, Bülent Ecevit Üniversitesi Tıp Fakültesi Fizik Tedavi ve Rehabilitasyon AD, 67600, Zonguldak, Türkiye. E-mail: seldaki@hotmail.com.

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TABLE 1. Demographic Data and Clinical Findings of Patients With and Without History of Falls

	History of Falls (+)	History of Falls (−)	*P*
Age, y	45.6 ± 11.8	39.6 ± 11.2	0.001
Sex (F/M)	71.4	67.5	>0.05
Duration of disease, y	17.5 ± 12	12 ± 9.2	0.001
Sick leave due to disease, d	6.1 ± 2.9	8.6 ± 3.2	>0.05
ESR, mm/s	26.4 ± 23.5	23.6 ± 19.3	>0.05
CRP, mg/dL	3.9 ± 1.6	4.7 ± 0.6	>0.05
BASDAI	3.9 ± 2.2	3.7 ± 2.3	>0.05
BASMI	4.9 ± 2.8	3.2 ± 2.2	0.002
BASFI	4.4 ± 2.9	2.9 ± 2.4	0.000
SPPB	7.7 ± 3.5	9.9 ± 2.2	0.000
25(OH) vitamin D, ng/mL	25.9 ± 16.5	24.7 ± 24.3	>0.05

F indicates Female; M, Male.

Recommended Assessment of Spondyloarthritis International Society score set was used in the clinical evaluation, and the Bath AS Disease Activity Index (BASDAI) to assess disease activity of patients. Fatigue, spinal and peripheral joint pain, localized tenderness, and duration and severity of morning stiffness were noted with 10-cm visual analog scale for BASDAI evaluation.[16] Functional status of the patients was measured using the Turkish version of Bath AS Functional Index (BASFI).[17] The validity and reliability of the Turkish version of BASDAI and BASFI have previously been investigated.[10,17] Following the determination of Bath AS Metrology Index (BASMI) scores, cervical rotation, tragus-wall distance, modified Schober test, lateral lumbar flexion, and intermalleolar distance, calculations were carried out using the BASMI-linear scale.[16]

In addition to the above parameters, fear of falling, the number of falls within the last year, history of fractures, use of medication that increases fall risk (such as sedatives, antidepressants, or myorelaxants), multiple-drug use (>4 medication-related/unrelated with AS), lower-extremity involvement (hip, knee, or ankle joint), and 25-hydroxyvitamin D (25(OH) vitamin D) levels were also evaluated.

Physical performance and balance were primarily assessed by using the SPPB.[18] This battery consists of 3 major items including a balance test, a 4-m walking test (gait speed), and repeated chair stands. The balance test begins with a semitandem stand. The subjects who are unable to hold this position try the side-by-side position. Those who are able to stand in the semitandem position test again in the full tandem position. The participants are asked to hold each position for 10 seconds. For gait speed, the subjects walk the course with a distance of 4 m at their usual walking speed. The time to complete the course is measured twice, and the best time is used. Patients who use a cane or other walking aids outside their home are allowed to use them for the test. For the repeated chair stands, the subjects were asked to stand up straight as quickly as they can and then to sit down while keeping their arms folded across the chest. It is performed 5 times without a break. Then the total score that ranges from 0 (bad) to 12 (very good) is obtained by adding those 3 test scores.

Statistical Analyses

Statistical analyses were performed using the SPSS 16.0 program. When evaluating the data, descriptive statistical methods such as mean, SD, percent distribution, and frequency analysis were used. The independent-variables *t* test, Pearson correlation test, and Spearman ρ correlation test were used for data analysis.

RESULTS

A total of 306 (217 male and 89 female) AS patients with mean age of 40.1 ± 11.5 years were included in the study. Forty (13%) of 306 patients reported falls within the last year.

Demographic properties, disease characteristics, and risk factors for falls of patients with or without a history of falls were given as mean ± SD and percentage in Tables 1 and 2, respectively. Statistically significant differences were found between the patients with and without a history of falls regarding age ($P = 0.001$), disease duration ($P = 0.001$), history of fractures ($P = 0.035$), fear of falls ($P = 0.000$), hip involvement ($P = 0.032$), BASMI ($P = 0.002$), BASFI ($P = 0.000$), and SPPB ($P = 0.000$).

No significant correlations were found between number of falls and gender, morning stiffness, polypharmacy, knee involvement, ankle involvement, usage of antidepressants or myorelaxants, AS-related days of sick leave, BASDAI, sedimentation, CRP, and 25(OH) vitamin D levels ($P > 0.05$ for all parameters).

Statistically significant correlations were found between number of falls and age ($R = 0.117$, $P = 0.041$), disease duration ($R = 0.160$, $P = 0.005$), AS-related lost job ($R = 0.140$, $P = 0.014$), fear of falling ($R = 0.316$, $P = 0.000$), hip involvement ($R = 0.112$, $P = 0.05$), BASMI ($R = 0.234$, $P = 0.000$), BASFI ($R = 0.244$, $P = 0.000$), and SPPB ($R = 0.183$, $P = 0.006$).

In relation to falls, the most frequently seen fracture was forearm fracture. Thirteen patients had a history of forearm fractures. Five foot and ankle fractures, 4 tibial fractures, 2 femur fractures, and 1 mandibular fracture were present in patients. Five of them were related with falling (3 forearm, 1 ankle, and 1 tibia fractures).

DISCUSSION

Vertebral fractures are common and well-known complications in patients with AS. Prevention of vertebral fractures requires not only screening and treatment of osteoporosis but also fall prevention strategies. Identification of factors that increase the risk of falls in patients with AS should be included in preventive strategies. A fall risk assessment has been carried out in many chronic illnesses[19–22] as well as in healthy geriatric population.[23–26] Former studies demonstrated that chronic musculoskeletal pain increases the risk of falling.[19,22,27,28] The relation between chronic pain and fall risk is a complex interaction of factors including

TABLE 2. Risk Factors for Falls in Patients With and Without History of Falls

	History of Falls (+), %	History of Falls (−), %	*P*
Job loss due to disease	37.8	22.6	0.039
Hip involvement	62.5	44.4	0.032
Knee involvement	15	14.3	>0.05
Ankle involvement	15	13.5	>0.05
History of fractures	15	8.3	0.035
Fear of falling	47.5	13	0.000
Use of antidepressants	7.5	4.9	>0.05
Use of muscle relaxants	12.5	10.6	>0.05
Multiple-drug use	80	83.3	>0.05

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sleep disturbances, decreased attention, social withdrawal, medication usage, functional limitation, gait changes, and limitation of activity. Although it is thought that AS patients have increased risk of falls, there is no consensus on clinical indicators or tests that could be used in the assessment of these risks.

In recent years, studies examining the postural stability in AS patients have been published.[11,12,14,29–31] However, different results have been reported in these studies. Some authors reported bad postural balance in patients with AS,[11,14,29] whereas others reported no difference in postural balance between AS patients and control subjects.[12,30,31] Swinkels and Dolan[32] suggested that proprioception was disrupted because of enthesitis and causes loss of balance. Zebouni et al[33] examined the walking pattern of AS patients and determined that their hip and knee flexion angles were smaller and that their average stride length was shorter. In addition, authors suggested that patients felt more vibration during walking due to ankylosis and therefore walked more carefully to reduce this feeling.[33] Biomechanical studies suggested that ability to prevent a fall in the event of tripping depends on where the center of gravity is located at the time of the trip.[34] An anterior shift of the center of gravity due to the flexed posturing or decreased hip range of motion (especially extension) may be associated with falling when a trip occurs in patients with AS. In our study, we found statistically significant correlation between the number of falls and BASFI as well as BASMI, whereas there was no significant relationship with BASDAI. On the other hand, Alkan et al[13] reported a significant correlation between the risk of falls and BASDAI, BASFI, and BASMI. Because BASMI and BASFI reflect the chronic structural changes of the disease, they can be considered as more important risk factors than BASDAI and other disease activity indexes for falls in patients with AS.

We did not find any correlation between falling and ESR and CRP levels, whereas hip involvement was determined as a risk factor of fall in our patients. The authors who investigated fall risks in patients with rheumatoid arthritis did not find any correlation between either the presence of autoantibodies or increases in acute phase reactants CRP[19,35,36] and ESR[19,36,37] and fall risk. On the other hand, they determined that swollen and tender lower-extremity joints were modifiable risk factors for falls.[19,22] In a review of 16 fall-risk studies concerning geriatric population, 1 of the priority risks identified was the presence of any type of arthritis, which had a higher mean relative risk of predicting future falls than either age or cognitive status.[38] People with hip or knee osteoarthritis are at a higher risk of falls, and their future risk significantly increases if they have joint pain and prior history of falling.[39,40] Although studies have shown that some biomechanical compensation has occurred in the hip joint to provide balance,[30,33,41,42] none of the studies have investigated the hip joint involvement as a separate parameter that has an effect on falls in AS. In our study, we determined that hip involvement occurred more frequently in patients with a history of falls.

In many studies that investigate risk of falling, the SPPB has been an objective assessment of a physical performance, which incorporates static balance, walking, and time for repeated chair rise.[23,28,34,43,44] We found that AS patients with a history of falls had lower SPPB scores. It was also determined that these patients had a longer duration of the disease, restricted spinal movements, and worse functional levels. These results support the view that with increased duration of disease, the risk of falls also increases.[13] In determining the risk of falls in patients, it is important to establish which of the routinely used follow-up parameters could be used as markers. Thus, the protection of patients at high risk of falls and close monitoring in terms of a fracture development may be possible.[13] Feldtkel et al[45] determined recommendations for patients' behavior such as avoiding activities of high-risk and environmental adaptations. One of these recommendations includes measures to reduce the patients' risk of falls. Health professionals can specify patients who are at a particular risk of falls by inquiring if they have fallen in the past year. Patients would benefit from a risk assessment tool that consists of systematic physical examinations including BASMI and BASFI scores, SPPB test (evaluation of lower-extremity functioning and balance), and determination of hip involvement and limitations. When the results are obtained from this tool, clinicians should inform the patients in terms of the possible complications and risk factors of falls. We believe that patients should be introduced to a rehabilitation program including specially planned exercises, which can reduce the risk of falls, as well as avoiding activities that create the risk of falling.

The fear of falling is related to subjective feeling of poor health and which leads to restriction of activities of daily living, deteriorated physical function, limited functional independence, and damaged self-image.[29] It is known that fear of falling is not only the immediate result of falls but also a risk factor of falls. Cho et al[29] investigated the relationship between fear of falling and physical performance among rural elderly people. They suggested that a greater fear of falling is associated with poorer physical performance. Similar results were reported by Deshpande et al.[44] They suggested that severe fear-induced activity restriction was a significant independent predictor of accelerated increase in disability in activities of daily living. Although it was expected to have low-level fear of fall in our study because our patients were younger; progressive ankylosis, chronic inflammation and functional limitation may be relevant to high-level fear of fall in patients with AS. The presence of back, joint, or muscle pain has been found to increase the likelihood of fear of falling reports 2 to 4 times in geriatric population.[24–26] Jamison and colleagues[24] reported that the presence of more intense pain was significantly associated with increased fear of falling in adults with arthritis. We found statistically significant correlation between number of falls and fear of falling. Similar to our results, Stanmore and coworkers[22] researched risk factors for falling in rheumatoid arthritis, and they found that multiple fallers have significantly higher levels of fear of falling compared with single fallers or no fallers.

There are some limitations of this study, such as inability to perform patients' radiographic examination and the lack of information on the presence of uveitis. Recall bias resulting from patients remembering their falls within the last year might be another limitation of our study.The large number of participants in our study increases the power of the obtained results and is the strongest aspect of our study. Another strong aspect of our study is carrying out the evaluation and the implementation of the fall risk by a very simple clinical test (SPPB).

Asking for a history of falls will highlight those at high risk for further falls, followed by the assessment of pain, stiffness, fatigue, and lower-extremity involvement. Also functional status and physical performance may be good predictors of falls for AS patients. Patients with AS would benefit from a fall-risk screening tool that utilizes the most clinically relevant and significant risk factors associated with falling. With the use of fall risk factors that were found from the study, a risk assessment tool can be generated. The parameters that we propose for this purpose are history of falls in the last year, determination of hip involvement and limitations, BASMI and BASFI scores, and the results of the SPPB test. In addition, it is also important to question the fear of falling. We suggest that targeting interventions toward these risk factors could reduce the burden of falls in patients with AS; however; further studies are required to confirm our results. Considering the high rates of morbidity and mortality due to fractures caused by falls, it is important to evaluate the risk

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factors of fall and to prevent these factors in the rehabilitation of patients with AS.

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