Fall Risk in Patients with Ankylosing Spondylitis

Ankilozan Spondilitli Hastalarda Düşme Riski

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Objectives: The aim of this study was to investigate whether patients with ankylosing spondylitis (AS) have a higher fall risk than healthy subjects and to determine whether fall risk is associated with the clinical features of AS.

Patients and methods: Forty AS patients (28 males, 12 females; mean age 37.20±9.92 years; range 20 to 60 years) who met the modified New York criteria and 40 age and gender-matched healthy controls were included. All participants were assessed by a static posturography device which provided numerical values in the percentage for fall risk. Patient interviews were used to assess the history of falls for the previous 12 months. The following tools were used for all AS patients: The Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) for disease activity, the Bath Ankylosing Spondylitis Functional Index (BASFI) for function, the Bath Ankylosing Spondylitis Metrology Index (BASMI) for spinal mobility, and the Ankylosing Spondylitis Quality of Life (ASQoL) questionnaire for quality of life.

Results: There were no differences in the sociodemographic characteristics among the AS patients and the healthy controls (p>0.05). The mean fall risk was significantly higher for the AS patients compared to the controls (p<0.05). The ratio of AS patients who had a positive history of falls was significantly higher than controls (p<0.05). Fall risk was positively and significantly associated with the BASDAI (r=0.713, p<0.001), BASFI (r=0.751, p<0.001), BASMI (r=0.527, p<0.001), and ASQoL (r=0.627, p<0.001). The fall risk was not associated with the age, sex, body mass index and disease duration (p>0.05).

Conclusion: Fall risk increased in patients with AS which was associated with poor spinal mobility, functional status, quality of life and higher disease activity. Increased risk of falling should be taken into consideration in the rehabilitation of the patients with AS.

Key words: Ankylosing spondylitis; fall risk; posturography.

Amaç: Bu çalışmada, ankilozan spondilitli (AS) hastaların sağlıklı bireylerden daha fazla düşme riskine sahip olup olmadığı ve düşme riski ile AS'nin klinik özellikleri arasında herhangi bir ilişki olup olmadığı araştırıldı.

Hastalar ve yöntemler: Modifiye New York kriterlerine uyan AS'li 40 hasta (28 erkek, 12 kadın; ort yaş 37.20±9.92 yıl; dağılım 20-60 yıl) ile yaşları ve cinsiyetleri eşleştirilmiş 40 sağlıklı kontrol çalışmaya dahil edildi. Tüm katılımcılar, düşme riski yüzdesi olarak bize sayısal değerler sunan statik posturografi cihazı ile değerlendirildi. Hasta görüşmelerinden son 12 ay içindeki düşme öyküsü de belirlendi. Tüm AS hastalarına şu araçlar uygulandı: hastalık aktivitesi için Bath Ankilozan Spondilit Hastalık Aktivite İndeksi (BASDAI), fonksiyon için Bath Ankilozan Spondilit Hastalık Fonksiyonel İndeksi (BASFI), spinal mobilite için Bath Ankilozan Spondilit Metroloji İndeksi (BASMI) ve yaşam kalitesi için Ankilozan Spondilit Yaşam Kalitesi (ASQoL) anketi.

Bulgular: Ankilozan spondilitli hastalar ile sağlıklı kontroller arasında sosyodemografik özellikler bakımından fark yoktu (p>0.05). Ortalama düşme riski, AS'li hastalarda kontrollere kıyasla, anlamlı olarak yüksekti (p<0.05). Ankilozan spondilitli hastalarda pozitif düşme öyküsüne sahip olanların oranı kontrollerden yüksekti (p<0.05). Düşme riski ile BASDAI (r=0.713, p<0.001), BASFI (r=0.751, p<0.001), BASMI (r=0.527, p<0.001) ve ASQoL (r=0.627, p<0.001) arasında pozitif ve anlamlı ilişki vardı. Düşme riski yaş, cinsiyet, vücut kütle indeksi ve hastalık süresiyle ilişkili bulunmadı (p>0.05).

Sonuç: Ankilozan spondilitli hastalarda kötü spinal mobilite, fonksiyonel durum, yaşam kalitesi ve yüksek hastalık aktivitesi ile ilişkili olan düşme riski artmıştır. Yüksek olan düşme riski AS'li hastaların rehabilitasyonunda dikkate alınmalıdır.

Anahtar sözcükler: Ankilozan spondilit; düşme riski; posturografi.

Ankylosing spondylitis (AS) is a chronic, inflammatory rheumatic disease that primarily affects the axial skeleton, peripheral joints, and entheses.[1] The clinical signs of the disease can range from mild stiffness to a totally fused spine and may include any combination of severe bilateral hip involvement, peripheral arthritis, or extraarticular manifestations.[2]

Ankylosing spondylitis is a disease with a varied natural history which sometimes has an insidious onset and slow progression. Predicting the course of the disease is difficult as periods of remission and relapse can occur at any stage. Additionally, even with treatment, permanent posture and movement problems, such as loss of spinal mobility, restriction of motions at peripheral joints, and decreased expansion of the chest[3] can develop in patient with AS. Ventral flexion of the head and neck, increased thoracic kyphosis, shortening of the hip and knee flexors are responsible for the characteristic posture of AS patients. Furthermore, spinal and peripheral joint involvement may result in physical limitations and disability,[4] and the propensity for falling could increase because of the poor posture and impaired mobility. Therefore, understanding the impact of AS on fall risk may elucidate the possible mechanism that causes disability in this patient population and permit more effective management of this disease. A few studies[5-9] exist that have focused on postural balance in patients with AS, but these produced conflicting results. Furthermore, there is no quantitative data on fall risk related to AS. The Tetrax Interactive Balance System is reliable for evaluating postural balance and has been used to evaluate fall risk in some clinical studies in recent years.[10-12]

The aim of this study was to investigate whether patients with AS have a higher fall risk than healthy subjects and to determine if there was any association between this risk and the clinical features of AS.

PATIENTS AND METHODS

Participants

Forty AS patients (28 males, 12 females; mean 37.20±9.92 years; range 20 to 60 years) who fulfilled the modified New York criteria[13] and forty age- and gender-matched healthy controls were enrolled in this study. All individuals provided their written informed consent to participate, and the study was approved by the university research ethics committee. Patients who had been diagnosed with AS for at

least one year were included. Those with vestibular disorders, concomitant neurological or psychiatric disease, severe visual or auditory impairments, and orthopedic problems in the lower extremities due to other issues were excluded from the study. After a detailed physical examination that included anthropometric measurements to determine body mass index (BMI), the participants' demographic information was obtained. In addition, the patient's history of falls for the previous 12 months was ascertained via interview. A fall was defined as an unintentional coming to the ground or other lower level without sustaining a violent blow, loss of consciousness, or sudden onset of paralysis, as occurs with a stroke or epileptic seizure.[14] Retrospective falls were also assessed during the interview.

Assessment of fall risk

All subjects in the study were tested using the Tetrax Interactive Balance System (Sunlight Medical Ltd., Tel Aviv, Israel), which uses posturography, a method based on the assessment of vertical pressure fluctuations on four independent force plates, each placed beneath the two heels and toes of the subject while standing in an upright position. The standard examination consists of eight positions that are held for 32 seconds. Two of the positions occur with the head straight and eyes open while standing on a solid surface and elastic pads, respectively. Two more are in the same position but with the eyes closed. Two additional positions are with the head turned to the left and right while standing on a solid service, and the remaining two positions are the same but with the head tilted down. The software of the Tetrax system elaborates stability, weight distribution, synchronizations, and sway intensity. A fall index derived from the balance parameters established by this device has been developed to produce a score that expresses this risk based on the patient's specific balance factors that affect falling. This score rates the risk on a scale from 0-100 in which 0 indicates no risk of falling and 100 represents the extreme likelihood of falling.[10] All of our participants were tested in the afternoon to avoid morning stiffness.

Assessment of patients with AS

The Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) is a patient- reported measure of AS disease activity. This index uses a 10 cm visual analog scale (VAS) to measure the severity of fatigue, spinal and peripheral joint pain, localized tenderness,

and morning stiffness in patients with AS. The final BASDAI score ranges from 0-10, with lower numbers representing less severe disease activity.[15]

The Bath Ankylosing Spondylitis Functional Index (BASFI) consists of 10 questions designed to determine the degree of functional limitation in patients with AS. Each question is answered using a 10 cm VAS with a recall period of the previous week. The mean of the ten scales gives the BASFI score a value between 0 and 10, with lower scores indicating less functional limitation. [16] It has been proven that the Turkish versions of the BASDAI and BASFI are reliable and valid.[17,18]

The Bath Ankylosing Spondylitis Metrology Index (BASMI) is a validated composite index of four spinal measures (cervical rotation, tragus-to-wall distance, the modified Schober's test, and lateral lumbar flexion) and one hip mobility measure (intermalleolar distance). Each measure is assigned a score from 0-2, with higher scores signifying greater impairment in mobility.[19]

The Ankylosing Spondylitis Quality of Life (ASQoL) scale is a disease-specific instrument designed to measure health-related quality of life in patients with AS and contains 18 yes or no questions with a total score ranging from 0-18. Lower scores represent better QoL.[20]

Statistical analysis

All statistical analyses were performed using the SPSS version 15.0 for Windows software program (SPSS Inc., Chicago, IL, USA). Descriptive statistics were used for the demographic characteristics. For continuous variables, the significance of the differences was analyzed using Student's t-test while categorical variables were analyzed with a chi-square test. The median value for the fall risk index was calculated for both the patients with AS and the healthy controls. In order to determine whether there was a difference in the ratio of fallers between the individuals who had a fall risk index either below the median value or above the median value, a chi-square test was utilized. An analysis was performed for both study groups, and Spearman's correlation coefficient was calculated to determine the relationship between the clinical features and the risk of falling within the AS group since some of these variables were on an

Table 1. Demographic characteristics and fall risk in the patients with ankylosing spondylitis and the controls

	AS patients (n=40)			Controls (n=40)			
	n	%	Mean±SD	n	%	Mean±SD	p
Gender							
Male	28	70		28	70		
Female	12	30		12	30		
Age (years)			37.20±9.92			37.50±9.63	0.891
Body mass index (kg/m^2)			24.30±3.55			23.52±3.88	0.349
Fall risk index			40.22±26.72			24.32±12.27	0.001
History of falls							
No	32	80		38	95		0.043
Yes	8	20		2	5		
Fall risk index for non-fallers			30.34±16.88			22.82±10.58	0.033
Marital status							
Single	9	22.5		9	22.5		
Married	29	72.5		28	70		0.897
Widow(er)	2	5		3	7.5		
Education							
Primary school	19	47.5		17	42.5		
High school	8	20		12	30		0.761
University	13	32.5		11	27.5		
Vocation							
Unemployed	7	17.5		6	15		
Housewife	10	25		7	17.5		
Government official	11	27.5		12	30		0.959
Employee	7	17.5		9	12.5		
Self-employed	2	5		2	5		
Retired	3	7.5		4	10		

AS: Ankylosing spondylitis; SD: Standard deviation.

ordinal scale. In all analyses, *p* values of <0.05 were considered to be statistically significant.

RESULTS

There were no differences between the AS patients and the controls regarding the sociodemographic characteristics (p>0.05). The mean fall risk index of the AS patients was significantly higher than for the control group (40.22±26.72 and 24.32±12.27, respectively) (p<0.05) (Table 1). Also, when we analyzed the difference in the fall risk index between the two groups by excluding those who had a fall history, the mean fall risk indices were reduced to 30.34±16.88 and 22.82±10.58 for the non-falling AS patients and healthy controls, respectively. However, there was still a statistically significant difference in the fall risk index between the two groups of participants with no history of falling (p=0.033) (Table 1). Furthermore, the distribution of the fall risk index scores in the patients with AS differed significantly from the controls (Figure 1). The ratio of fallers was also higher among the AS patients (p<0.05). In addition, the AS patients with a Tetrax fall risk index of lower than 36, the median value, had no history of falling within the previous year, whereas those with a score of 36 or higher had a 40% positive history of falling. (p<0.05) (Table 2).

The disease duration of the AS patients was between one and 29 years (median 7 years). Thirty

percent of these patients had peripheral articular involvement, and 15% had extraarticular findings. On the other hand the median values of AS disease-specific instrument scores were BASDAI 3.5, BASFI 2.4, BASMI 1.5, ASQoL 9.5 respectively (Table 3).

Fall risk and BASDAI (r=0.713, p<0.001), BASFI (r=0.751, p<0.001), BASMI (r=0.527, p<0.001), ASQoL (r=0.627, p<0.001) were positively and significantly associated. Whereas age, gender, body mass index and disease duration were not found to be related with fall risk (p>0.05) (Table 4).

DISCUSSION

In this cross-sectional study, we investigated whether patients with AS have a higher fall risk than healthy controls and tried to determine which clinical and demographical factors are associated with this phenomenon. Our results demonstrated significant differences between the AS and control subjects according to fall risk and history of falling. The BASDAI, BASFI, BASMI, and ASQoL were also found to be positively associated with fall risk in the patients with AS. However, we could not establish a correlation between fall risk and age, gender, BMI, or disease duration.

Since AS leads to permanent posture and mobility problems, the number of studies investigating the postural stability of these patients has increased in
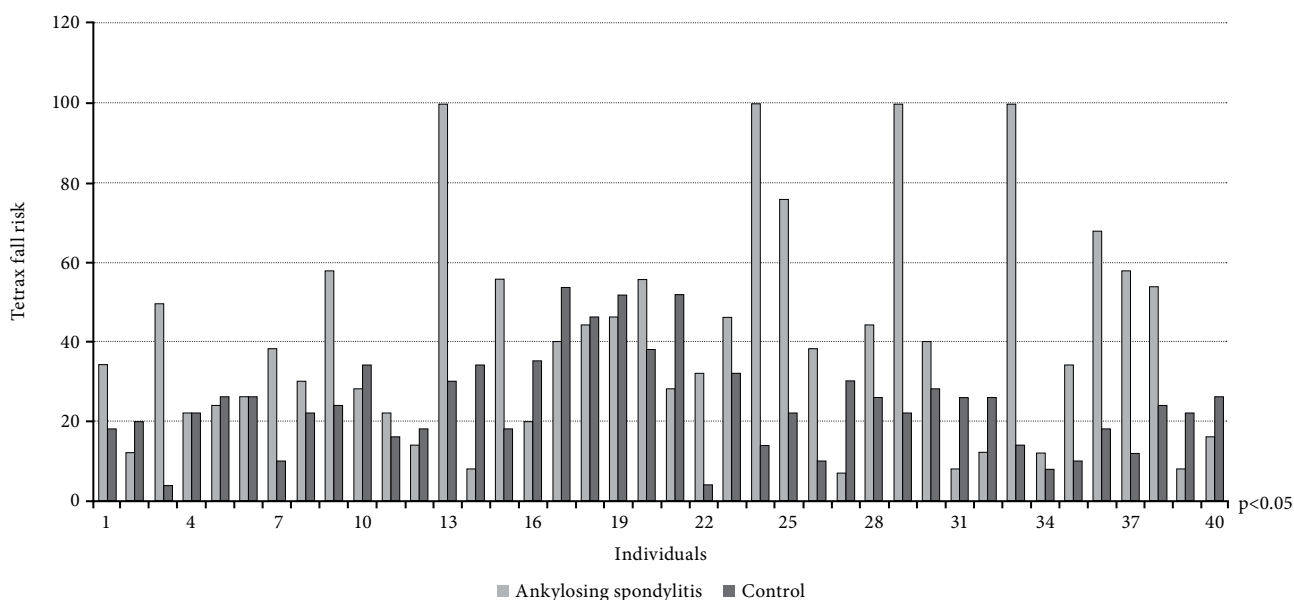
Figure 1. The distribution of fall risk index scores in patients with ankylosing spondylitis and controls.

Table 2. Fall history according to the median fall risk index in the patients with ankylosing spondylitis and the controls

	Fall history				
	Negative		Positive		
	n	%	n	%	p
Fall risk index for AS patients					
Above the median fall risk (≥36)	12	60	8	40	0.002
Below the median fall risk (<36)	20	100	0	0	
Fall risk index for controls					
Above the median fall risk (≥23)	18	90	2	10	0.244
Below the median fall risk (<23)	20	100	0	0	

AS: Ankylosing spondylitis

recent years,[5-9] but there have been conflicting results. Some studies[5,8,9] reported that AS patients had poor postural balance, but others[6,7] noted good postural balance in those with this disease. Murray et al.[5] were the first to show by quantitative measurement that a significant proportion of AS patients have poorer balance than normal subjects. They used sway magnetometry to evaluate balance and suggested that poor balance was not a problem for all AS patients and that the majority were actually within normal limits. In another study, it was shown that postural stability, as evaluated by the Biodex System SD (Biodex Medical Systems, Inc. Shirley, NY, USA) decreased in patients with AS, especially in advanced cases.[8] Furthermore, in a recent study by Vergara et al.,[9] they concluded that standing postural control, which was evaluated by static force platforms, was altered in patients with AS. In accordance with these

studies, we determined that the fall risk index derived from balance factors was higher in patients with AS and that significantly more AS patients than healthy controls had a positive history of falls. Disease-specific instruments of AS that reflect the progression of disease have also been correlated with the fall risk index. In contrast to these studies, Aydog et al.[6] evaluated 70 AS and 35 healthy controls using the Biodex System SD to determine the dynamic postural balance and suggested that AS had no negative effect on postural stability. In another study, Adam et al.[7] utilized the same Tetrax Interactive Balance System that we used to evaluate stability, sway intensity, and weight distribution and to investigate whether AS patients had poorer balance than healthy subjects due to postural changes. They found no statistically significant differences in the balance parameters between the two groups. However, Adam et al.[7]

Table 3. Clinical variables in the patients with ankylosing spondylitis (n=40)

	n	%	Median	Min.-max.
Disease duration (years)			7	1-29
Bath Ankylosing Spondylitis Disease Activity Index			3.5	0-8.8
Bath Ankylosing Spondylitis Functional Index			2.4	0-9.2
Bath Ankylosing Spondylitis Metrology Index			1.5	0-10
Ankylosing Spondylitis Quality of Life			9.5	0-18
Peripheral arthritis				
Absent	28	70		
Present	12	30		
Extraarticular findings				
No	34	85		
Yes	6	15		
Medicine				
Only non-steroidal anti-inflammatory drug	3	7.5		
Non-steroidal anti-inflammatory drug + DMARD	22	55		
Biological agents	12	30		
Non-steroidal anti-inflammatory drug + biological agents	3	7.5		

DMARD: Disease modifying antirheumatic drug; Min.: Minimum; Max.: Maximum.

Table 4. Relationship between clinical features and fall risk index in patients with ankylosing spondylitis

	Fall risk index Spearman's correlation coefficient (Spearman's rho)	
	r	p
Gender	-0.062	0.706
Age	-0.021	0.898
Body mass index	0.055	0.736
Duration of disease	0.276	0.085
Bath Ankylosing Spondylitis Disease Activity Index	0.713	<0.001
Bath Ankylosing Spondylitis Functional Index	0.751	<0.001
Bath Ankylosing Spondylitis Metrology Index	0.527	<0.001
Ankylosing Spondylitis Quality of Life	0.627	<0.001

reported that the reason why they found no balance problems was possibly due to the small numbers of patients with severe disease, such as dorsal kyphosis, a source of postural impairment, in their studies. The same authors also concluded that postural balance might have been compensated for by other unaffected joints in the lower extremities. Unlike those studies, almost one-third of our patients had severe disease with notable postural impairment.

Poor postural balance is one of the major risk factors for falling,[21] and deterioration in postural stability in patients with AS may contribute to the number of falls. Currently, no instruments exist that can determine the fall risk in patients with AS, and to our knowledge, this is the first study involving AS patients that has attempted to compare fall risk with healthy controls. In order to examine balance in the AS patients, we assessed the fall risk using a static posturographic device. Retrospective falls were also assessed during the patient interviews. We found significant differences in the fall risk and history of falls between the patients with AS and healthy controls. In addition, we demonstrated that AS patients who had a positive history of falls have a higher fall risk index than non-falling AS patients. This result may be explained by the impaired balance in AS due to postural and biomechnical changes.

Fall index assessment with the Tetrax Interactive Balance System is designed to assess the individual's risk of falling, and this index reflects balance factors that influence this risk, including contrast sensitivity, proprioception, and sway.[22] Recent studies[10,23] have reported that in a sample of non-institutionalized elderly people over the age of 65, a posturographic evaluation appears to be a more sensitive tool than clinical tests for identifying patients who are at high risk for recurrent falls.

There is data suggesting that patients with AS have an increased rate of spinal cord injuries (SCIs),[24-26] which is directly correlated with the increased incidence of vertebral fractures and fracture risk that is associated with the risk of falling and osteoporosis in AS patients.[24] Hence, understanding the impact of AS on fall risk and determining which clinical features are associated with this risk should be an important goal for healthcare professionals involved in the treatment of AS patients. Moreover, having the ability to identify the risks related to future falls is necessary in order to target high risk patients for preventive intervention.

Since disease-specific instruments of AS reflect the progression of disease, the correlation between these tools and fall risk is expected. Potential contributors to altered postural control may include pain, inflammation, axial stiffness, and increased mechanical stiffness of the affected joints, all of which determine disease activity, spinal mobility, functional impairment, and QoL.[9] Thus, changes in disease-specific instruments of AS may lead to impaired postural control and the association of altered postural control with increased fall risk. Previous data related to the association between balance and the clinical features of AS are contradictory.[5-9] Durmuş et al.[8] concluded that the decreased postural stability in patients with AS was associated with increased kyphosis seen during the course of the disease. However, another study showed

that postural control was related to measurements of functional impairment and disease activity as determined by clinical indices.[9] In addition, Aydog et al.[6] observed a positive correlation only between tragus-to-wall distance and postural balance. No other correlation was detected between stability indices and the BASMI or disease duration of their patients. In yet another study, Murray et al.[5] showed no significant relationships between balance and any of the quantitative descriptions of posture. Finally, Adam et al.[7] also found no correlations between balance parameters and the quantitative measurements of posture and disease duration. In this study, we demonstrated that increased fall risk was associated with poorer spinal mobility, functional status, QoL, and higher disease activity in patients with AS.

Our study had a few potential limitations, including its cross-sectional design and the relatively small sample size. Moreover, the indirect assessment of fall risk and unavailability of data related to the prospective frequency of falls precluded us from making clear assertions.

In conclusion, the risk of falling in AS patients was higher than for healthy controls in this study. In addition, poorer spinal mobility, functional status, QoL, and higher disease activity for AS were found to be related to an increased fall risk. Further longitudinal studies with larger AS patient groups are required to more accurately identify the risk of falling in these patients and to clearly define the relationship between fall risk and clinical features.

Declaration of conflicting interests

Funding

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