COMPARISON OF EFFICACY OF BALANCE EXERCİSES AND PORTABLE BALANCE SYSTEMS ON BALANCE IN PATİENTS WİTH ANKYLOSING SPONDYLITIS ANKYLOSİNG SPONDYLITIS AND BALANCE

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ABSTRACT

Aim: *In this study it is aimed to compare the balance and risk of falling in Ankylosing Spondylitis (AS) patients with aged-matched healthy controls. Another objective is to assess the effects of given treatments on the balance and clinical status of the patients using a randomized, controlled study model.*

Methods: *40 AS patients and 20 healthy volunteers were compared in terms of falling risk. Then, 40 AS patients were divided into 2 groups. First group was prescribed conventional exercises with portable balance system while second group received conventional exercises followed by balance exercises. Patients were assessed using falling risk, visual analogue scale (VAS), Bath Ankylosing Spondylitis Disease Activity Index (BASDAI), Bath Ankylosing Spondylitis Metrology Index (BASMI), Bath Ankylosing Spondylitis Functional Index (BASFI), Short Form-36 (SF-36), 6- minute walking distance and chest expansion parameters.*

Results: *AS patients were found to have significantly higher falling risk compared to healthy controls ($p<0.05$). This increase in falling risk was shown to have a statistically significant relationship with 6-minute walk distance in correlation analysis ($p<0.05$). There were significant increases in both in Group 1 and 2 in terms of VAS, BASDAI, BASMI, BASFI, SF-36 and 6-minute walk distance and chest expansion values following treatment ($p<0.05$). However, no significant improvement was seen in falling risk of those patients ($p>0.05$).*

Conclusion: *AS patients have a significantly higher falling risk and they showed significant clinical improvements following treatments. Since balance problems are clinical findings in AS which might cause disabilities, balance exercise programs must be included in the treatment program of the patients.*

Keywords: Ankylosing Spondylitis, balance rehabilitation, portable balancing system

INTRODUCTION

Ankylosing Spondylitis (AS) is a chronic, advancing and multisystem disease with unknown etiology which is characterized by significant inflammation that causes bone fusion around spinal joints and surrounding tissues.[1]It is thought that genetic, environmental and immunological factors all play a role in the pathogenesis of this disease. The main complaints seen in AS patients are pain, stiffness, physical limitations, fatigue, sleep disorders and depression. AS might also cause physical disability by affecting the mobility of the spine and joints. In those patients, functional weakness, increased significance of symptoms and disruption of physical wellness in general makes the treatment compliance difficult as well as causing psychological problems; which causes a significant disruption of the patients' quality of life.[2]

Even though it is known for a long time that AS is a disease that is highly likely to cause a physical disability, early diagnosis, treatment and patient education can all decrease the risk of disability today. The basic supportive medical treatments used in AS are non-steroid anti-inflammatory drugs (NSAIDs), tumor necrosis factor inhibitors (Anti TNF) and physiotherapy.[3,4] Physical therapy is especially effective in improving the functional capacity of patients by increasing joint mobility.[5,6]

Inclusion of lateral and rotational mobility exercises and balance training to conventional exercises that increase body extension might be useful in decreasing balance problems seen in AS patients.

Portable balance system is a tool that includes several treatment programs using a falling risk analysis and an evaluation of balance with posture graph measurement principle and can also be used in rehabilitation.[7,8] Biofeedback measures and displays the biological actions which are normally not felt (such as pulse or blood pressure) and allows the improvement of those actions by providing information both to the clinician and the patient which is normally not gathered with conventional exercise. Biofeedback (BF) devices do not produce stimulation but instead they only project the physiological changes they detect. They are used today to quantitively measure the balance disruption in diseases which might affect balance and in several rehabilitation programs.

The main objective of our study is to compare the Ankylosing Spondylitis (AS) patients with healthy controls in addition to assess the relationship between possible balance problems seen in those patients with the age, disease duration, BMI, Bath Ankylosing Spondylitis Disease Activity Index (BASDAI), Bath Ankylosing Spondylitis Metrology Index (BASMI), Bath Ankylosing Spondylitis Functional Index (BASFI), Short Form-36 (SF-36), 6 minute walking distance and chest expansion

values. Moreover, we also planned to assess the effects of conventional rehabilitation program and balance exercises conventionally used in AS patients and again, the additional portable balance system exercises prescribed to AS patients on the balance problems, risk of falling, clinical symptoms, functional status and disease activity with a randomized controlled prospective study design.

MATERIALS AND METHODS

The study included 40 AS patients diagnosed with Modified New York Criteria that came to Rheumatic Diseases Clinic in Physical Medicine and Rehabilitation Department of Ataturk University Faculty of Medicine and 20 healthy volunteers as controls between August 2013 and April 2014. The patient group which included 40 patients (6 females, 34 males) was divided into 2 randomized groups by their presentation date. The first group received conventional rehabilitation program and portable balance system exercises for 3 weeks with 5 sessions per week. The second group received conventional rehabilitation program and balance exercises, again for 3 weeks with 5 sessions per week. The control group which consisted of 2 females and 18 males were only compared with AS patients following the measurement of their falling risk with portable balance system.

The conventional exercise program that was given to both patient groups included hip flexor, shoulder and back extensor, right-left latissimus dorsi, lumbar and cervical area muscle contraction exercises, range of motion (ROM) exercises, spinal mobility exercises which includes cat-camel and breathing exercises. This was followed by 3 balance games in Group 1 which included swinging from right-left plane, front-back plane and a combination of those 2 games. Group 2 received balance exercise program which included standing on one foot in front of a mirror, lateral stepping, front-back, right-left balance study on balance board and reciprocal leg and arm raises on crawling position.

Patients were evaluated prior to treatment (0. Week), at the end of treatment (3^{rd} week) and 12 weeks after the beginning of the treatment (12^{th} week) in total of three times by the clinician who developed and practiced the exercise program for the patients.

The medical treatments patients were on were not changed. Patients' age, sex, height, weight, BMI, previous systemic disease presence, disease duration, BASRI, medical treatments they were on and back pain scores were all put on file. Falling risk of all individuals included in the study was measured using Tetrax Balance Device. For balance test, the patient was asked to stand on a 4-point balance platform and to follow the movements shown by the system which measured balance abilities of the patients. Falling risk was calculated by analyzing the measurement results. Pain was evaluated using 10-cm scaled visual analog scale (VAS).[9] The disease activity was evaluated by BASDAI,[10,11] functional status with BASFI,[12,13] spinal mobility with BASMI[12-14] and quality of life with SF-36[12] scales. Finally, 6-minute walking test was used to evaluate submaximal functional capacity of the patients.

SPSS For Windows was used to analyze the study data. The data was expressed as numbers, percentages, medians, mean and standard deviation. Kolmogorov-Smirnov test was used to evaluate the normal spread of the groups. Fisher's Exact test and chi-square tests were used for the analysis of categorical variables such as sex and NSAID usage in Tetrax and balance groups. Mann-Whitney U test was used to analyze quantitative variables such as VAS and BMI in addition to analyzing the differences between two measurements in two groups. Friedman test was used in the analysis of the differences between 1^{st}, 2^{nd} and 3^{rd} measurements in both Tetrax and balance group. To pinpoint the group that caused the difference in Friedman test analysis, Bonferroni correction was applied and Wilcoxon test was used for dual comparisons. The significance level of this test was defined as

$p<0.017$ (p/dual comparison number = p/3). The significance level for the analyses apart from this test was defined as $p<0.05$.

RESULTS

Our study groups consisted of 20 patients (M/F:16/4) in Group 1 and 20 patients (M/F:18/2) in Group 2. The control group also had 20 healthy individuals (M/F:18/2). There was no statistically significant difference between the groups in terms of age, sex, height, weight, BMI, previous systemic disease, disease duration, presence of back pain and BASRI scores ($p>0.05$). Although there was no difference in terms of demographics between Groups 1,2 and 3, falling risk was significantly higher in Group 1 and 2 which included the patients compared to the Group 3 (the controls) ($p<0.05$). No significant improvement was detected both within groups and between the groups in terms of falling risk after treatments[Table1].

Table 1: Baseline/postintervention comparisons in falling risk within and between the groups.

Falling risk	Grup 1 ort±SS/median	Grup2 ort±SS/median	p
1.control	49.40±26.58/47.00	52.80±32.80/51.00	p>0.05
2. control	57.60±29.44/46.00	50.00±31.44/43.00	p>0.05
3. control	46.20±24.89/46.00	52.35±29.33/45.00	p>0.05
p	p>0.05	p>0.05	

A correlation analysis was performed to detect the parameters which affect the AS patients' falling risk. A statistically significant relationship was found between 6-minute walking distance and falling risk. Although falling risks increased with BASMI, the relationship was not found to be significant.

After the treatment programs, there was a significant improvement within groups in terms of VAS, BASDAI, BASFI, BASMI, SF-36, 6-minute walking distance and chest expansion ($p<0.05$), yet no difference was detected between the groups($p>0.05$)

DISCUSSION

AS is a chronic, systemic, progressive inflammatory disease with an unknown etiology which starts from sacroiliac joints and then spreads to vertebrae, apophyseal joints and ligaments and is usually characterized by chronic lower back pain in patients that might cause limitations in spinal mobility. It is usually diagnosed during 2^{nd}-3^{rd} decades of life in young males with genetic affinity to HLA-B27 antigen.[15]

The best management for AS today is a combination of pharmacological and non-pharmacological treatments. In Toussirot and Wendling's literature review; the basis of AS treatments includes patient education, regular exercise program and using NSAIDs.[16]

Postural control or "balance" is the ability to keep the static supportive surface with minimal movement and to complete a dynamic task while on a fixed position. The factors that affect the balance include sensory information. Sensory information includes motor responses that affect force, range of motion and coordination in addition to vestibular and somatosensory system.[17]

Limitation of spinal mobility is the basic finding of the disease. Flattening of lumbar lordosis and increasing thoracic kyphosis is common. Spinal kyphosis causes a shift towards front and back in

the body's gravity center. In order to keep the balance, the person has to correct those shifts. For this reason, the patients compensate using ankle plantar flexion, hip extension and knee extension to maintain postural control during the day.[18]ASAS recommends the evaluation of spinal mobility of the patients as the basic factor in both clinical practice and studies.[19]

Although there is several studies about decreasing pain, joint range-of-motion limitations and spinal stiffness and increasing functionality in AS patients, there are not enough studies on the subject of postural disturbances and related functional balance effects caused by AS symptoms in the patients. An objective review of falling risk in AS patients, defining the affecting factors and decreasing this risk by an effective method will help optimizing the approach to these patients. In our study, we evaluated falling risk of AS patients using an objective and quantitative method and compared this to healthy controls. Our aims also included defining the risk factors for falling and assessment of the effects of two different exercise programs on the balance using a randomized controlled prospective study.

Our study used posturography, an objective method which measured falling risk of AS patients and the results showed us that the falling risk of those patients were significantly higher compared to healthy controls. A study done by Aydog et al reported that AS caused no negative effect on postural stability. As opposed to this study done by Aydog et al, our study supports the idea that the postural changes in patients affected by AS can affect the balance in a negative way. Another study done my Murray et al that included 38 AS patients and 58 healthy controls reported a worse balance in AS patients compared to healthy controls.[20]Likewise, Souza et al's study that included 30 AS patients and 30 healthy controls showed that the balance is worse in AS patients compared to controls.[21]

Balance problems in public and falling can cause important issues in people with various health problems.[22]Falling can cause various results from loss of self-esteem to injuries or even death.[23 In general, rheumatic diseases count as the second most important independent risk factor in serious falls that cause injuries.[24]Although it seems logical that the falling frequency is increasing with rheumatic diseases, studies on falling and balance problems in this patient group seem to be quite limited. The studies on falling risks in patients with rheumatic diseases show a great degree of variance in terms of risk factor and frequency data, mainly caused by the differences in methods measuring falling risks. In addition, the present studies on the literature mainly contains the results gathered from RA patients, which limits the data on balance and falling risk of AS patients further. In different studies, falling risk in RA patients were reported between 10-50%, which is quite a wide range.[25]This wide range is caused by the different methods that evaluate falling risk of the patients.

Including RA, rheumatic diseases are thought to be related with increased falling risks. However, the factors that affect the falling risk seem to be contradictory.[23]In our study, the factors that we found out to be associated with the increased risk of falling were 6-minute walking distance and BASMI meanwhile age, sex, BMI, BASDAI, BASRI and BASFI showed no correlation with that. In the literature, A study done by Antenolli-Incalzi et al on 783 healthy elder individuals, the authors evaluated the relationship between occiput-wall distance and balance and reported that in both males and females, increased occiput-wall distance is strongly related to balance disorders.[25]In our study, when we looked at the correlations, although there was an increase in falling risks with BASMI was detected, this was not found to be statistically significant.

Etiology of balancing problems and falling is a multifactorial entity which includes the interaction of intrinsic, behavioral and environmental factors with age and comorbidities defined as the most important risk factors.[26]Butler A et al's study measured functional balance and mobility in

50 young individuals between 20-39 and 684 elderly individuals between 65-98. Their results showed that elderly individuals showed a worse performance in functional balance and mobility tests compared to young individuals and that there was a significant relationship between functional mobility tests and age.[27]

In our study, we did not detect a significant relationship between age and balance. This might be explained by exclusion of patients over 65 in our study. Since disability and permanent damage are thought to be related to longer disease activity periods, we can argue that falling risk potential is increased in early term AS independent of damage in both male and female patients. Interestingly, falling frequency in RA is also seem to be age-independent.[28]Moreover, disease period was not shown to be a significant factor in falling risks.[29]

In our study, effectiveness of the portable balance system exercises to the balance used in Group 1 was not shown to be statistically significant. The balancing exercises given to Group 2 showed a slight improvement in balance in 0-3rd week controls, yet this was also not found to be statistically significant. During controls of Group 1 and 2, no difference was detected between the groups. Again, no significant difference was seen in improvements. This might be affected by the short period of treatments given at the hospital, the permanent deformities the patients have and the amount of pain in patients. The similar positive effects seen with different exercise methods can be explained by the general improvement of the conditions obtained by the exercises.

Following the exercise programs, both groups showed improvement in VAS, BASDAI, BASFI, BASMI, SF-36, 6-minute walking distance and chest expansion values. Aytekin et al's study reported significant decrease in BASDAI, BASFI and chest expansion scores following a 12-week treatment.[30]Sweeney et al's randomized controlled study on the effectiveness of home exercising programs which included 155 patients reported a significant improvement in BASFI and BASDAI scores of the group that received exercise therapy for 6 months.[31]Again, Karatepe et al's home exercising program showed significant improvement in BASFI, BASMI, BASDAI scores of AS patients and that they stopped using NSAIDs.[32]In Karapolat et al's study, 41 patients were divided into two groups as group therapy and home exercise group and their BASMI, BASFI and BASDAI were measured following a 6-week exercise program; with both groups showing significant improvements.[33] Karapolat et al's study that included 45 AS patients showed a significant increase in 6-minute walking distance in patients prescribed walking and swimming exercises.[34]

Our study is one of the few studies that assess the effect of axial skeletal involvement in AS patients on the balance and the used portable balance system and balance exercises on the improvement of balance. Although there are contradicting studies found in the literature on the effect of AS on balance, there are no studies that compare portable balance exercises with balance exercises, which makes our prospective study a first in the literature on this subject. To make better comparisons, wider studies are indicated.

There are several limitations of our study. First, the number of subjects included in the study is relatively small. Second, the duration of the treatment is relatively short. Treatments with longer durations might yield more accurate results.

In conclusion; no superiority of portable balance system combined with conventional exercises was seen over balance exercises combined with conventional exercises, yet they both showed significant improvements in clinical status of the patients. Balance exercises should not be overlooked in the rehabilitation of AS patients and most definitely should be included in their exercise programs.

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