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Original Article

Association Between Age, Gender, HbA1c Level, Fasting Plasma Glucose Level, and the Ultrasonographic Findings in Patients With Shoulder Tendinosis

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ABSTRACT

Objective: The aim of this study was to investigate the association of age, gender, HbA1c level, fasting plasma glucose level, and ultrasonographic findings in patients with shoulder tendinosis.

Methods: Patients with tendinosis (n=178) in the biceps brachii and/or supraspinatus tendon and healthy controls (n=181) were included. The demographic and clinical characteristics were recorded. Two blinded radiologists performed the ultrasonographic evaluation on the shoulders bilaterally. Also, HbA1c and fasting blood glucose levels were measured.

Results: In the tendinosis group, 54.7% of the participants were females and 37.1% of participants were males (P=.002). The number of participants over the age of 50 years was found to be increased in the tendinosis group than in the control group (P=.004). The number of patients with HbA1c levels between 5.7 and 6.4 was found to be increased in the tendinosis group (P=.014). Bilateral biceps and supraspinatus tendon thicknesses were significantly increased in the tendinosis group over 50 years old ($P < .05$). Right and left biceps tendon calcifications were found to be increased in those over 50 years old in the tendinosis group (P=.011 and P=.027, respectively). In the tendinosis group, right and left supraspinatus tendon calcifications were found to be increased in those over 50 years old (P=.009 and P=.013, respectively).

Conclusions: This study shows that being female and over 50 years old and having HbA1c levels between 5.7 and 6.4 increased the development of tendinosis susceptibility.

Keywords: HbA1c, shoulder tendons, tendinosis

INTRODUCTION

Shoulder tendon pathologies are important causes of shoulder pain and more than 50% of the general population is affected by tendon rupture by the age of 60 years.[1] Tendon pathologic changes may be due to degeneration, microtrauma, and vascular origin, as well as the shape of the acromion, dislocation, glenohumeral impingement, overuse syndromes, and various demographic factors.[2,3] Shoulder calcific tendinitis was reported in 2.5%-7.5% of healthy shoulders in adults, and of those, 70% of patients were women in the fourth and fifth decades of life.[4-12]

Shoulder tendons are generally affected by smoking, diabetes mellitus, hypocholesteremia, and thyroid disease.[1] Diabetes mellitus potentially causes damage to vascular systems, internal organs, and soft tissues including cartilage and tendons.[13] Previous studies have reported that shoulder tendon thicknesses increase and degenerative changes are more frequent in diabetic patients compared to healthy controls.[14,15] Old age is another risk factor of

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shoulder tendon pathologies.[16] Although there are many studies on shoulder tendon pathologies in the literature, we did not find any study evaluating demographic, clinical, and laboratory findings of patients with tendinosis. Knowing the demographic, clinical, and laboratory characteristics of patients with shoulder tendinosis will be helpful in determining the modifiable and non-modifiable factors in the development of shoulder tendinosis. It will also contribute to the prevention of shoulder tendon ruptures and the development of primary and secondary prevention strategies. For this reason, we aimed to investigate the association of age, gender, HbA1c level, fasting plasma glucose level, and the ultrasonographic findings in patients with shoulder tendinosis in our study.

METHODS

This was planned as a cross-sectional study. All participants were evaluated with ultrasonography in the Radiology Clinic and participants with tendinosis in the biceps brachii and/or supraspinatus tendons in ultrasonography (n=178), and participants with normal shoulder tendon ultrasonography (n=181) were included in the study. Patients with known rheumatologic disease, ischemic heart disease, neurological disease, rotator cuff tendon rupture, and a history of shoulder surgery were excluded from the study. Furthermore, patients who take statin treatment and patients who had thyroid disorders or hypercholesterolemia were excluded. The demographic features and clinical characteristics were recorded. Two radiologists, experienced in musculoskeletal ultrasonography and blinded to the participants' medical history, performed the ultrasonographic evaluation. Measurements were done on the shoulder bilaterally with a linear probe (7.5-14 MHz; Toshiba Xario SSA-660A and Hitachi HI Vision Preirus gray-scale real-time sonography) according to standard protocol.[17] Supraspinatus, infraspinatus, subscapularis, and biceps brachii tendons on both dominant and non-dominant arms were evaluated. The radiologist stood behind the participants. The participants sat with their elbows at 90° flexion. Biceps tendons were evaluated in a neutral position; the subscapularis tendons in maximum external rotation; the supraspinatus, infraspinatus tendons and acromiohumeral distances in 60° internal rotation.[17]

HbA1c and fasting blood glucose levels were measured at least after a 12-hour overnight fast. All samples were collected between 07:30 and 09:30 AM.

The study protocol was approved by the Local Ethics Committee (Ankara Training and Research Hospital, Ethic Committee, decision number: 5269, date: February 10, 2016). A well-written informed consent was obtained from all participants according to the principles of the Helsinki Declaration.

Statistical Analysis

All data were analyzed using the Statistical Package for Social Sciences (IBM SPSS Corp., Armonk, NY, USA) 22.0 program for Windows. Visual and analytical methods were used for investigation to determine whether or not the variables are normally distributed. Continuous variables were expressed as mean ± SD and categorical variables as numbers and percentages. Chi-square and Fisher's exact test were used in the analysis of categorical variables. The independent 2-group averages were analyzed by Student's *t*-test, and multiple-group comparisons were analyzed by analysis of variance test in the analysis of parametric variables. The independent 2-group averages were analyzed by the Mann-Whitney *U*-test and the multiple-group comparisons were analyzed by the Kruskal–Wallis test in the analysis of non-parametric variables.

RESULTS

Patients with tendinosis (n=178) in the biceps brachii and/or supraspinatus tendon, controls (n=181) were included. Age, gender, HbA1c, and fasting blood glucose levels were presented in Table 1. In the tendinosis group, 54.7% of the participants were females and 37.1% of participants were males ($P=.002$). The number of participants over the age of 50 years was increased in the tendinosis group than in the control group ($P=.004$). The number of patients with HbA1c level <5.7 was significantly fewer in the tendinosis group (Table 1). The number of patients with HbA1c levels between 5.7 and 6.4 was found to be increased in the tendinosis group (Table 1). There was no significant difference in fasting plasma glucose levels between tendinosis and control groups (Table 1).

Right and left biceps tendon thicknesses were significantly increased in the tendinosis group over 50 years old ($P=.007$ and $P=.008$, respectively) (Table 2). Right biceps tendon thickness was significantly increased in patients with >6.5 HbA1c level than in patients with <5.7 HbA1c level ($P=.012$). Left biceps tendon thickness was significantly increased in both patients with 5.7-6.4 HbA1c and >6.5 HbA1c levels ($P=.016$ and $P=.007$, respectively).

MAIN POINTS

- Being female and over 50 years old and having HbA1c levels between 5.7 and 6.4 increased the development of tendinosis.
- Biceps tendon calcification was found to be increased in patients who were over 50 years old in patients with tendinosis.
- In the tendinosis patients, supraspinatus tendon calcification was found to be increased in patients over 50 years old.

Table 1. Age, Gender, HbA1c, and Fasting Blood Glucose Levels in Tendinosis and Control Groups

	Tendinosis Group	Control Group		
	n=178	n=181	n	*P*
Gender				**.002**
Female	139 (54.7)	115 (45.3)	254	
Male	39 (37.1)	66 (62.9)	105	
Age (years)				**.004**
<50	50 (39.4)	77 (60.6)	127	
≥50	128 (55.2)	104 (44.8)	232	
HbA1c (%)				
<5.7	77 (48.7)	81 (51.3)	158	**.003**
5.7-6.4	50 (65.8)	26 (34.2)	76	**.014**
≥6.5	51 (40.8)	74 (59.2)	125	.183
Fasting blood glucose (mg/dL)				
<100	87 (51.8)	81 (48.2)	168	.442
100-125	48 (44.4)	60 (55.6)	108	.234
≥126	43 (51.8)	40 (48.2)	83	.997

Data are presented n (%). $P < .05$ is statistically significant.

Right and left supraspinatus tendon thicknesses were significantly increased in the tendinosis group over 50 years old ($P=.034$ and $P=.024$, respectively). There was no statistical association between supraspinatus tendon thicknesses, HbA1c, and fasting blood glucose levels (Table 3).

Right and left biceps tendon calcification was found to be increased over 50 years old in the tendinosis group ($P=.011$ and $P=.027$, respectively). There was no

Table 2. Right and Left Biceps Tendon Thickness According to Gender, Age, HbA1c, and Fasting Blood Glucose Level in Patients With Tendinosis

	Right Biceps Brachii	*P*	Left Biceps Brachii	*P*
Gender				
Female	4.09 ± 1.04	.144	4.09 ± 1.12	.746
Male	3.76 ± 0.76		3.98 ± 1.0	
Age				
<50	3.73 ± 0.88	**.007**	3.69 ± 0.65	**.008**
≥50	4.13 ± 1.01		4.21 ± 1.20	
HbA1c (%)		**.025**		**.009**
<5.7	3.81 ± 0.98		3.83 ± 1.11	
5.7-6.4	4.11 ± 0.96		4.27 ± 1.16	
≥6.5	4.23 ± 0.99		4.19 ± 0.93	
Fasting blood glucose (mg/dL)		.060		.061
<100	3.86 ± 1.01		3.91 ± 1.11	
100-125	4.13 ± 0.92		4.15 ± 1.11	
≥126	4.20 ± 0.98		4.26 ± 1.01	

$P < .05$ is statistically significant.

Table 3. Right and Left Supraspinatus Thickness According to Gender, Age, HbA1c, and Fasting Blood Glucose Level in Patients With Tendinosis

	Right Supraspinatus	*P*	Left Supraspinatus	*P*
Gender				
Female	6.94 ± 1.34		6.64 ± 1.41	
Male	6.97 ± 1.29	.551	6.79 ± 1.18	.547
Age				
<50	6.59 ± 1.02		6.31 ± 1.25	**.024**
≥50	7.08 ± 1.40	**.034**	6.82 ± 1.37	
HbA1c (%)	6.79 ± 1.22		6.47 ± 1.36	.240
<5.7	6.80 ± 1.37	.059	6.81 ± 1.44	
5.7-6.4	7.32 ± 1.37		6.84 ± 1.25	
≥6.5				
Fasting blood glucose (mg/dL)	6.86 ± 1.27		6.55 ± 1.36	.459
<100	6.83 ± 1.35	.060	6.74 ± 1.51	
100-125	7.25 ± 1.37		6.85 ± 1.17	
≥126				

$P < .05$ is statistically significant.

significant association between bilateral biceps tendon calcification, gender, HbA1c, and fasting blood glucose levels in the tendinosis group ($P > .05$). In the tendinosis group, right and left supraspinatus tendon calcification was found to be increased in those patients over 50 years old ($P=.009$ and $P=.013$, respectively). In the tendinosis group, right and left supraspinatus tendon calcification risk was found significantly increased in patients with HbA1c >6.5 compared to in patients with HbA1c 5.7-6.5 ($P=.005$ and $P=.004$, respectively).

In the tendinosis group, there was no statistical association between bilateral biceps tendon focal hypoechoic area and loss of fibrillar pattern, gender, age, HbA1c, and fasting blood glucose levels ($P >.05$). In the tendinosis group, there was no statistical association between the right supraspinatus tendon focal hypoechoic area and loss of fibrillar pattern, gender, age, HbA1c, and fasting blood glucose levels ($P >.05$). Focal hypoechoic area and loss of fibrillar pattern in the left supraspinatus is significantly increased in patients with tendinosis older than 50 years.

DISCUSSION

In this study, we found that being female and over 50 years old and having an HbA1c level between 5.7 and 6.4 increased the development of tendinosis. We did not find any relationship between fasting plasma glucose level and tendinosis. Similar to our study, age above 50 years, diabetes mellitus, and overhead activities were found risk factors for shoulder tendinopathies, in a systematic review.[16]

We found that bilateral biceps brachii and supraspinatus tendon calcification were related to age above 50 years in the tendinosis group. We did not find any relationship between bilateral biceps brachii tendon calcification and HbA1c levels in the tendinosis group. But we found that bilateral supraspinatus tendon calcification was increased in patients with HbA1c >6.5 in the tendinosis group. Our results indicate that the risk of tendinosis may increase in patients with diabetes mellitus and patients who were over 50 years old. Also, the risk of tendinosis may increase in patients with increased HbA1c levels.

The details of the relationship between diabetes mellitus and tendinopathies are not fully known. Some studies often emphasize the possible association between tendon changes and diabetes mellitus.[18] There is a biological pathway in which diabetes-related hyperglycemia affects collagen crosslinks and reduces proteoglycan content in tendons.[19] The most frequent result in some systematic studies is the increase in tendon thickness.[20] Similarly, we found that increased biceps brachii tendon thicknesses were associated with increased HbA1c levels in tendinosis patients. Aktürk et al[21] and Papanas et al[22] showed that Achilles tendon thickness increases in patients with diabetes mellitus; but this thickness difference was only found in female patients. Similarly in our study, there was a significant relationship between having female gender and tendinosis. Abate et al[14] reported that subacromial bursitis was more common in diabetic patients. However, in our study, we did not evaluate subacromial bursitis in diabetic patients.

Calcific tendinitis is more common in supraspinatus tendon.[23] Similarly we found that bilateral biceps brachii and supraspinatus tendon calcifications were increased over 50 years old in tendinosis patients. Also, we found that bilateral supraspinatus tendon calcifications were increased in patients with HbA1c >6.5 in tendinosis patients. Disorders of thyroid and estrogen metabolism may cause calcific tendinitis.[23]

Thyroid disease, hypercholesterolemia, and chronic kidney disease may cause shoulder tendon pathologies.[1,24] Buyuksireci et al[25] showed that the presence of autoimmune thyroid disease may lead to increased shoulder tendon thickness and this was independent of thyroid hormone levels. In this study we excluded the participants who had other metabolic and endocrine diseases such as thyroid disease, hypercholesterolemia, and chronic kidney disease.

To the best of our knowledge, there are no studies determining tendinosis and HbA1c and fasting blood glucose levels, although there are studies evaluating the relationship between diabetes and tendon thickness in the literature. In our study, tendinosis risk was significantly increased in patients with 5.7-6.4 HbA1c levels. Increased tendinosis risk was expected in the patients with HbA1c levels ≥6.5, but no statistically significant increased risk was detected. The study also included patients treated for diabetes mellitus and on a diet. Therefore, patients with HbA1c levels of 5.7-6.4 may have been newly diagnosed and not treated for diabetes. Eventually, we do know the effects of diabetes mellitus treatment on shoulder tendon pathogenesis.

Similar to our study, Abate et al.[14] considered it to be dishomogeneity, diffuse or focal hypoechoic/hyperechoic tendon thickening, loss of normal fibrillar pattern and/or irregularity in tendon contours as a sign of degeneration. When the relationship between age, gender, HbA1c, and fasting blood glucose level and the presence of focal hypoechoic area and loss of fibrillar pattern, only a statistically significant relationship was found between age and presence of focal hypoechoic and loss of fibrillary pattern in the left supraspinatus tendon. This result can be explained by the weakness of the left side and the predisposition to degeneration because the right dominant extremity is more common in society.

The limitation of our study is that minor trauma, duration of diabetes mellitus, treatment, diet, and physical activity levels are unknown. A prospective, longitudinal study should be undertaken to confirm our studies.

This study shows that being female and over 50 years old and having HbA1c levels between 5.7 and 6.4 increased the tendinosis susceptibility. Also, bilateral biceps tendon calcification was found to be increased in patients who were over 50 years old in patients with tendinosis. In the tendinosis patients, bilateral supraspinatus tendon calcification was found to be increased in patients over 50 years old. Additionally, bilateral supraspinatus tendon calcification was found to be associated with age, HbA1c, and fasting blood glucose levels.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Ankara Training and Research Hospital (Date: February 10, 2016, Number: 5269).

Informed Consent: A well-written informed consent was obtained from all participants according to the principles of the Helsinki Declaration

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