Ultrasonography evaluation of tendon thickness in hemodialysis patients

Avaliação ultra-sonográfica da espessura dos tendões de pacientes submetidos a hemodiálise

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ABSTRACT

Objective: To evaluate tendon thickness at ultrasonography (US) imaging in long-term dialysis recipients. Methods: Twenty chronic dialysis recipients underwent US examination to evaluate tendon thickening, including that of the supraspinatus, subscapularis, biceps, triceps, quadriceps, patellar and calcaneal tendons with no partial or complete lesions. These patients were compared with 22 asymptomatic patients and the rejection of null hypothesis was 5% (Student’s t test, p < 0.05). Results: Statistically significant thickening was found in the supraspinatus, subscapularis, triceps and right biceps tendons. The statistical analysis of the other tendons was not significant. Conclusion: Amyloid protein deposition in tendons was not uniform; the current study shows a predominance of this occurrence in tendons in the upper limbs.

Keywords: Tendons/ultrasonography; Renal dialysis; Ultrasonography

RESUMO

Objetivo: Avaliar a espessura dos principais tendões acessíveis à ultra-sonografia em pacientes dialíticos crônicos. Métodos: Vinte pacientes em regime de hemodiálise foram submetidos a ultra-sonografia para avaliar o espessamento de tendões, incluindo os tendões supra-espinais, subescapulares, cabeça longa do bíceps, tríceps, quadríceps, patelares e calcâneos, sem lesões parciais ou totais. Estes pacientes foram comparados com 22 pacientes do grupo assintomáticos e submetidos à análise estatística, fixando-se como 5% o nível de rejeição de hipótese de nulidade. Resultados: Encontramos espessamento estatisticamente significativo dos tendões supra-espinais, subescapulares, tríceps e do cabo longo do bíceps à direita. A análise estatística dos demais tendões não foi significativa. Conclusão: As alterações determinadas pela proteína amilóide não obedeceram a uma distribuição uniforme nos tendões estudados, predominando nos tendões dos membros superiores.

Descritores: Tendões/ultra-sonografia; Diálise renal; Ultra-sonografia

INTRODUCTION

Chronic renal failure (CRF) consists of progressive and irreversible loss of renal function (glomerular, tubular and endocrine) in a way that in its most advanced stages the kidneys are not able to maintain the patient’s internal medium(1).

Elevated levels of urea are the prevalent characteristics in CRF, whose functional diagnosis is based on the progressive and generally irreversible
reduction of glomerular filtration rate (GFR) caused by many illnesses; in that, the most common are glomerulonephritis, interstitial nephritis and diabetic glomerulosclerosis. Such patients present retention of toxic elements of the body metabolism which would normally be excreted in urine, such as urea, creatinine, uric acid and phosphorus. To prevent this accumulation of substances from impairing the organic balance in renal patients awaiting definitive transplantation, it is necessary to implement the renal replacement therapy by peritoneal dialysis or hemodialysis.

Hemodialysis is a procedure in which a machine cleans and filters the blood removing the harmful residues from the circulation by means of a dialyzer, that is, a special filter connected to the machine. The basic principles of hemodialyzer functioning consist of placing a semipermeable membrane between the blood and a cleaning or dialysis fluid. The toxic particles in higher concentrations in the blood are transported by diffusion mechanism to the dialysis fluid with the process stopping when the concentrations in both fluids are equal.

There are several complications related to CRF even in patients receiving renal replacement therapy. In the context of investigation of these conditions, the imaging methods are very important, especially ultrasonography, in diagnosis of conditions affecting the musculoskeletal system.

OBJECTIVE
This study intends to evaluate the thickness of the main tendons by means of ultrasonography in chronic renal patients receiving hemodialysis and to compare with the thickness of the same tendons in patients who were previously healthy.

METHODS
We evaluated 42 individuals divided into two groups - a study group and a control group -, and all patients enrolled in the study allowed agreed to have an ultrasonographic evaluation and answered a questionnaire which basically intended to obtain data, such as age, sex, time in dialysis therapy and the cause of CRF.

The study group was composed of 20 chronic patients who were already undergoing hemodialysis for an average of 4.5 years at Hospital Israelita Albert Einstein, in São Paulo. A patient in the study group presented complete and transfixing injury in the right supraspinal tendon and for this reason the mean thickness of this tendon was not included in the study.

Both groups underwent ultrasonographic evaluations carried out by the same operator (A.B.R.B) using high-resolution transducers (Philips HDI 5000, Philips En Visor®) for bilateral evaluation of tendon thickness in large joints.

The study included evaluation of the following tendons: supraspinal, subscapular, long head of the biceps, brachial triceps, femoral quadriceps, patellar ligament and calcaneal. Three measurements were performed and the largest and smallest were disregarded.

The shoulder was evaluated with the patient in standing position; supraspinal tendon was analyzed in internal rotation and the thickness was measured 1.0 cm away from the tendon insertion in the greater tuberosity of the humerus. Subscapular tendon was studied with the patient in maximum external rotation and its thickness was measured 1.0 cm away from the insertion in the lesser tuberosity of the humerus. The long head of the biceps tendon was evaluated in cross-sectional views in the intertubercular sulcus (figure 1).

Evaluation of the brachial triceps tendon was carried out with the patient in sitting position and 90° flexion of the elbow; its thickness was measured 1.0 cm from the olecranon insertion (figure 2).

Knee and ankle joints were examined with the patient lying and included evaluations of the femoral quadriceps tendon (figure 3), patellar ligament (figure 4) and calcaneal tendon with all measurements performed 1.0 cm from the respective insertions.

The results were analyzed using the Student’s t test, where 0.05 or 5% was the level of rejection of the null hypothesis, pointing out the significant values.

Figure 1. Cross-sectional view of the long head of biceps tendon evaluated in the intertubercular sulcus
RESULTS

From the total of 22 patients evaluated in the control group, 14 were males (63.6%) and 8 females (36.3%) with mean age of 53.3 years; while from 20 patients evaluated in the study group, 12 were males (60%) and 8 females (40%) with mean age of 46.7 years.

The main causes of renal failure were chronic glomerulonephritis, hypertension and diabetes, with the mean duration of dialysis treatment of 4.5 years, ranging from 8 months to 7.5 years.

Supraspinal tendon

The mean values of thickness measurements of this tendon in 20 patients from the study group were 5.0632 mm on the right with standard deviation of 0.42060 mm, and 4.85550 mm on the left with standard deviation of 0.40972 mm. Patients from the control group presented a mean thickness of 4.5273 mm on the right with standard deviation of 0.63259 mm, and 4.3727 mm on the left with standard deviation of 0.67201 mm (figure 5).

The comparison between the study group and control group with the Student’s t test showed statistically significant differences that were able to reject the hypothesis that the thickness was the same in both tendons.

Subscapular tendon

The mean values of thickness measurements of subscapular tendons in patients from the study group were 4.3900 mm on the right with standard deviation of 0.70180 mm, and 4.3150 mm on the left with standard deviation of 0.68309 mm. The means in the control group (n = 22) were 3.5136 mm on the right with standard deviation of 0.49502 mm, and 3.05591 mm on the left with standard deviation of 0.47875 mm (figure 6).

Comparisons of tendon thickness in the study and control groups showed significant differences.
Long head of the biceps tendon

The mean values of thickness measurements of this tendon in patients from the study group (n = 20) were 4.8200 mm on the right with standard deviation of 0.60140 mm, and 4.8750 mm on the left with standard deviation of 0.83909 mm. Evaluation of the control group (n = 22) showed mean thickness values of 4.4136 mm on the right with standard deviation of 0.41438 mm, and 4.5273 mm on the left with standard deviation of 0.57003 mm (figure 7).

The statistical analysis between the two groups showed significant differences when the right tendons were compared. The data obtained provide the basis to reject the hypothesis that the tendon thickness was the same in both study and control groups.

There were no statistically significant differences when we compared the long head of the biceps tendon on the left in the study group and the ipsilateral tendon in the control group.

Brachial triceps tendon

The mean values of thickness measurements of this tendon in patients from the study group were 3.7950 mm on the right with standard deviation of 0.40843 mm, and 3.6900 mm on the left with standard deviation of 0.44827 mm. Evaluation of the control group (n = 22) showed mean thickness values of 3.1227 mm on the right with standard deviation of 0.59034 mm, and 3.0273 mm on the left with standard deviation of 0.55307 (figure 8).

Comparison between the two groups demonstrated statistically significant differences in both sides, i.e., the data found are able to reject the proposed hypothesis.

Femoral quadriceps tendon

The mean thickness measurements of femoral quadriceps tendons in the study group were 4.3250 mm on the right with standard deviation of 0.89846 mm, and 4.2700 mm on the left with standard deviation of 0.53178 mm. The mean values in the control group (n = 22) were 4.0773 mm on the right with standard deviation of 0.53178 mm, and 4.0773 mm on the left with standard deviation of 0.53178 mm (figure 9).

Comparison between the groups did not show statistically significant differences.

Patellar ligament

The mean thickness measurements of patellar tendons in the study group were 3.8200 mm on the right with standard deviation of 0.55782 mm, and 3.8700 mm on
the left with standard deviation of 0.65059 mm. The mean values in the control group (n = 22) were 4.0955 mm on the right with standard deviation of 0.51407 mm, and 3.9318 mm on the left with standard deviation of 0.55668 mm (figure 10).

Comparison between the groups was not statistically significant to reject the proposed hypothesis.

**Calcaneal tendon**

The mean thickness measurements of calcaneal tendons in the study group (n = 20) were 4.0800 mm on the right with standard deviation of 0.95620 mm, and 4.0400 mm on the left with standard deviation of 0.82551 mm. The mean values in the control group (n = 22) were 4.0545 mm on the right with standard deviation of 0.71229 mm, and 3.8500 mm on the left with standard deviation of 0.64272 mm (figure 11).

Comparison between the groups did not show statistically significant differences.

**DISCUSSION**

Beta-2 (ß2) microglobulin is an 11.8-kDa polypeptide that is usually filtered in the glomeruli, reabsorbed in the proximal renal tubules and broken down into amino acids. Its main component is the amyloid protein. In chronic renal patients receiving hemodialysis, the hemodialyzer semipermeable membrane is unable to filter low molecular weight substances and consequently it is not efficient to filter ß2 microglobulin. When it reaches high blood concentrations, this substance starts to deposit in bones and soft tissues stimulating the development of a local inflammatory response that characterizes amyloidosis(7-8).

Amyloidosis is a debilitating and progressive disorder that occurs in 30% of patients undergoing dialysis for more than 10 years. Deposits can be found mostly in tendons, synovia and bones and may affect the shoulders, hips, hands, elbows and wrists. Typical lesions include tendon and joint capsule thickness, as well as the presence of echogenic deposits in bursae; ultrasonography is a non-invasive technique that is able to show the extension and anatomical sites of these abnormalities. The main abnormality evidenced by this method and indicative of dialysis-related amyloidosis is tendon thickening; however, this finding is inespecific since it can also be found in other diseases such as tendinosis, partial lesions and calcareous tendinitis(9-12).

Our study showed significant bilateral thickening of supraspinal, subcapular and brachial triceps tendons, as well as the long head of the biceps tendon on the right. Other tendons did not show statistically significant differences and this finding diverged from an experimental model described in the literature, including chronic dialysis patients who had tendon thickening secondary to the equal and uniform deposition of amyloid in the joints(9). However, Slavotinek et al. showed that chronic dialysis patients undergoing ultrasound examination of the rotator cuff presented significant thickening predominantly in the supraspinal, subcapular and long head of the biceps tendons when compared with infraspinal and teres minor tendons(12).

There are no reports in the literature about ß2 microglobulin predilection to deposit in supraspinal and subcapular tendons; however, the thickening found in these tendons as a consequence of amyloid deposition causes a reduction of the space called “rotator interval”, thus changing the “content-continent” ratio and predisposing the “impact” of these structures against the coracoacromial arch, functioning as an aggravating factor in the inflammatory response, a mechanism not applied to infraspinal and teres minor tendons(12). Another factor that justifies the non-equivalent tendon thickening in this study is the friction of humeral transverse ligament against the long head of the biceps tendon. This ligament overlaps the long head of the biceps tendon at the level of intertubercular sulcus and it is composed of the most superficial fibers of the subscapular
tendon. Thickening of these fibers by amyloid deposits as well as the long head of the biceps tendon itself makes this area more susceptible to friction and contributes to enhanced inflammatory response\(^{(12)}\), although there are no reports in the literature stating that this mechanism may cause more pronounced unilateral thickening as the one documented in this current study. This fact may be related to the high variability of data obtained.

Brachial triceps tendons in the study group also presented significant thickening, a fact that was not found or justified in the literature examined and all the tendons in the lower limbs did not show significant abnormalities among the groups.

Tendon thickening is directly related to the duration of dialytic treatment; the studies found in the literature included patients receiving hemodialysis for more than 10 years. In our study, patients had been treated with hemodialysis for 4.5 years. Therefore, new studies with longer duration of dialysis treatment are necessary to check the occurrence of non-equivalent tendon thickening and if this happens more intensely in the upper limbs, since the clinical manifestations of amyloidosis generally occur from 7 to 15 years after the beginning of hemodialysis\(^{(8-12)}\).

The current therapeutic options to contain the progression of amyloidosis secondary to hemodialysis aim to reduce the amyloid deposition in the tissues with the use of hyperpermeable membranes in the dialyzers allowing better filtration of β2 microglobulins, consequently reducing their serum concentration, as well as the use of drugs that are able to interfere in the aggregation of this protein\(^{(7)}\).

CONCLUSION

Manifestations determined by the amyloid protein did not follow an equivalent distribution in the tendons studied, with the presence of other factors such as “impact” and “friction” which offer a higher predilection to supraspinal, subscapular and long head of the biceps tendons.

There was a predominance of tendon thickening in the upper limbs in hemodialysis patients; new studies are necessary to show if this trend persists with longer duration of dialysis.

There was also a predominance of brachial triceps tendon thickness, a fact that has not been reported or explained in the literature.

REFERENCES


