ULTRASONOGRAPHIC EVALUATION OF THE RUPTURED MEDIAL HEAD OF GASTROCNEMIUS MUSCLE

AVALIAÇÃO ULTRASSONOGRÁFICA DA RUPTURA DA CABEÇA MEDIAL DO MÚSCULO GASTROCNÊMIO

EVALUACIÓN ULTRASONOGRÁFICA DE LA RUPTURA DE LA CABEZA MEDIAL DEL MÚSCULO GASTROCNEMIO

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ABSTRACT

Introduction: Tennis leg, a common injury of the medial head of gastrocnemius muscle in the muscle-tendon junction, is usually reported in men during recreational sports. Sudden pain is the main symptom accompanied by the feeling of rupture in the calf. Clinical examination followed by ultrasound is the standard diagnostic procedure. Objective: The main objectives of this study are to compare clinical and ultrasonographic findings in cases of tennis leg, evaluate the location and type of lesion in the medial head of gastrocnemius muscle, and evaluate the edema volume and the presence of deep vein thrombosis (DVT). Second, the healing process was monitored with ultrasound to distinguish the level of recovery and to record the presence of chronic sequelae. Methods: Eighty-one subjects with clinical symptoms of rupture of the medial head of gastrocnemius muscle participated in the study. A linear probe (7–12 MHz) was used for ultrasonographic (US) and a Doppler was used to verify the presence of DVT. Results: In 78 of 81 subjects examined, we found obvious US changes (96.3%) and three of them had no positive findings. In 67 of them, we diagnosed rupture of the medial head of the gastrocnemius muscle. Most of them had partial rupture (73.13%) and the remaining had total rupture (26.87%). The edema (30.84%) was found in the space between the aponeurosis of the gastrocnemius and soleus muscles. DVT with the clinical signs of tennis leg was observed in 5 of 81 patients (6.17%). Conclusion: Our findings indicate that ultrasound is very important for early diagnosis of muscle-tendon injuries in the leg. In addition, monitoring the healing process and assessing the chosen treatment showed a high efficiency. Ultrasonography is an effective method to identify and differentiate the sequelae of the injured muscles and vascular complications.

Keywords: sports medicine; athletic injuries; soft tissue injuries; ultrasonography.

RESUMO

Introdução: A "perna do tenista", lesão comum da cabeça medial do músculo gastrocnêmio na junção músculo-tendínea, em geral, é relatada em homens, durante a prática de esportes recreativos. A dor repentina é o principal sintoma, sendo acompanhada pela sensação de ruptura na panturrilha. O exame clínico seguido pelo exame de ultrassom é o procedimento diagnóstico padrão. Objetivo: Este estudo tem como principais objetivos comparar os achados clínicos e ultrassonográficos em casos de perna do tenista, avaliar a localização e o tipo da lesão na cabeça medial do gastrocnêmio e avaliar o volume do edema e a presença de trombose venosa profunda (TVP). Em segundo lugar, o processo de cicatrização foi monitorado com ultrassom para se distinguir o nível de recuperação e registrar a presença de sequelas crônicas. Métodos: Oitenta e um indivíduos com sintomas clínicos de ruptura da cabeça medial do gastrocnêmio participaram do estudo. Empregou-se uma sonda linear (7 a 12 MHz) para a avaliação ultrassonográfica (US) e Doppler para verificar a presença de TVP. Resultados: Em 78 dos 81 indivíduos examinados, foram encontradas alterações US evidentes (96,3%) e três deles não tiveram achados positivos. Em 67 pacientes, diagnosticamos ruptura da cabeça medial do músculo gastrocnêmio. A maioria deles apresentou ruptura parcial (73,13%) e os restantes tiveram ruptura total (26,87%). O edema (30,84%) foi encontrado no espaço entre a aponeurose dos músculos gastrocnêmio e sóleo. A TVP com sinais clínicos de perna do tenista foi verificada em 5 dos 81 pacientes (6,17%). Conclusão: Nossos achados indicam que o exame de ultrassom é muito importante para o diagnóstico precoce de lesões músculo-tendíneas no membro inferior. Além disso, constatou-se grande eficiência na monitoração do processo de cicatrização e na avaliação do tratamento aplicado. A ultrassonografia é um método efetivo para identificar e diferenciar as sequelas nos músculos lesionados e as complicações vasculares.

***Descritores**: medicina esportiva; traumatismos em atletas; lesões dos tecidos moles; ultrassonografia.*

RESUMEN

Introducción: La "pierna de tenista", lesión común de la cabeza medial del músculo gastrocnemio en la unión músculo-tendinosa, en general, es relatada en los hombres durante la práctica de deportes recreativos. El dolor repentino es el síntoma principal, acompañado de la sensación de ruptura en la pantorrilla. El examen clínico seguido de un examen de ultrasonido es el procedimiento de diagnóstico estándar. Objetivo: Los principales objetivos de este estudio son comparar los hallazgos clínicos y ultrasonográficos en los casos de pierna de tenista, evaluar la ubicación y el tipo de lesión en la cabeza medial del músculo gastrocnemio y evaluar el volumen del edema y la presencia de trombosis venosa profunda (TVP). En segundo lugar, el proceso de la curación se monitorizó con ultrasonido para diferenciar el

nivel de reparación y registrar la presencia de secuelas crónicas. Métodos: Ochenta y un sujetos con síntomas clínicos de ruptura de la cabeza medial del gastrocnemio participaron en el estudio. Se empleó una sonda lineal (7-12 MHz) para ultrasonografía (US) y Doppler para verificar la presencia de TVP. Resultados: En 78 de los 81 sujetos examinados, fueron encontrados cambios obvios en el US (96,3%) y tres de ellos no presentaran casos positivos. En 67 pacientes hemos diagnosticado ruptura de la cabeza medial del músculo gastrocnemio. La mayoría de ellos presentó ruptura parcial (73,13%) y los restantes tuvieron ruptura total (26,87%). El edema (30,84%) se encontró en el espacio entre la aponeurosis de los músculos gastrocnemio y sóleo. Se observó TVP con los signos clínicos de la pierna de tenista en 5 de 81 pacientes (6,17%). Conclusión: Nuestros hallazgos indican que la ultrasonografía es muy importante para el diagnóstico precoz de las lesiones músculo-tendinosas de la pierna. Además, hubo gran eficiencia en el monitoreo de la curación y la evaluación del tratamiento aplicado. La ultrasonografía es un método efectivo para identificar y diferenciar las secuelas en los músculos lesionados y complicaciones vasculares.

Descriptores: medicina deportiva; traumatismos en atletas; traumatismos de los tejidos blandos; ultrasonografía.

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INTRODUCTION

It was in 1883 when the clinical term "tennis leg" was introduced for the first time by Powell[1]. It marks the lesion of the medial head of the gastrocnemius muscle at the level of muscle – tendon aponeurosis (myotendinous junction). The peak of incidence is found in middle aged male population. Commonly, the injury is described as sudden pain followed by feeling of cracking in the calf. The majority of these incidents appear during recreational sports[2]. The clinical picture is presented with intense pain in the calf with the strongest sensation at the level of the myotendinous junction of the medial head of the gastrocnemius muscle, which intensifies during dorsal flexion of the foot. The pain in the calf gets stronger during walking and antalgic positioning is evident. The pain is relieved, but not entirely, during extension of the foot[3].

The diffuse pain initially spreads to the whole lower leg in, which could be misinterpreted during the process of diagnostics at this stage. Differential diagnostics of this type of pain could be high level Achill tendon ruptures, deep venous thrombosis (DVT), Baker cyst ruptures, abscess, stress fractures, compartment syndrome, arterial aneurism, tumors, etc.[4,5]. Incomplete and misdiagnosis of such clinical situation could have severe consequences to the general health of the patient[6].

For this reason, in modern clinical practice, we use ultrasonographic (US) procedures in diagnosing the "tennis leg" as a routine and reliable visualization method of choice. In the case of suspected rupture of muscle or tendinous structures the golden standard is performing the "stress test" during which the examiner has the opportunity to observe the degree and size of the defect in real time while the muscles are in contraction. There is no apparent contraindication for using US as a diagnostic tool except for open wounds. The results of this kind of evaluation are up to the quality of the US equipment and the skillfulness of the examiner. Treatment of either the partial or the total rupture of the medial head of the gastrocnemius muscle is in most cases conservative. Initial therapy is based on a standard protocol. After this initial treatment later therapy depends on clinical signs and the results of other diagnostic findings. The size of the injury will determine further plans of therapy[7]. The main goal of this study was to compare clinical with ultrasonographic findings in cases of tennis leg, and to evaluate the localization and type of lesions in the medial head of the gastrocnemius muscle and assess the size of liquid collections and presence of signs for deep venous thrombosis. We also monitored the healing process via ultrasound for distinguishing the level of recovery and to register presence of chronic sequels.

MATERIALS AND METHODS

This prospective study lasted for 23 months (from the 01/09/2011 to 01/08/2013.) during which we examined 81 patients with positive anamnesis and clinical signs of "tennis leg" with US. All of them gave their written informed consent to participate in the study. US examinations were conducted on an US machine - GE Voluson 730 (Zipf, Austria), with linear multi frequent probe 7 – 12 MHz, at the US department in Special Hospital for Rheumatic diseases (Novi Sad, Serbia). The Ethics Committee of the hospital approved the conduction of this study (number of protocol 521-8/2011). All investigations were carried out by the same ultasonographer – sports medicine specialist (licensed for US diagnostics of the locomotor disorders). The patients were previously examined by physicians of other specialties (sports medicine, orthopedics, physical medicine and doctors from the ER) and sent for further US evaluation in order to justify the suspicion of rupture of the medial head of the gastrocnemius muscle. Patients who had previous similar injuries by type or localization or vascular disorders and pain in the region of interest (i.e. lower leg) prior to the current injury were excluded from the study. The examination protocol was standardized. Patients were examined in a supine position face down. Transversal and longitudinal examination of the lower leg was performed together with the stress test, bilaterally. We were looking for evident lesions in the muscles and/or tendons of the lower leg in the form of rupture, or the presence of liquid collections. In the case of obvious vascular complications a vascular surgeon was called to perform Duplex scan of the lower leg and propose further therapy according to indications. In patients where rupture or liquid collections were found we performed US measurements for the size and localization. The US signs of rupture were visualized as clearly demarcated interruptions in the parallel echogenic and hypoechogenic lines of musculo – tendinous structures[8]. The positive findings were marked as partial or total rupture of musculo – tendinous structures. Figure 1 and Figure 2 show US findings during stress test in the rupture of the medial head of the gastrocnemius muscle and the presence of the liquid collection.

Presence or absence of signs of deep venous thrombosis (DVT) described as hyperechogenic changes in the venous lumen were confirmed via Duplex scan. Information on the time of persistence of cystic liquid collection was established as the time from injury to the moment of the last US verified presence of such collection after which the next control US examination did not prove its presence. Bilateral comparison was performed as well (Figure 3).

After the initial US examinations, in 67 (39 male, 28 female) patients we diagnosed rupture of medial head of gastrocnemius muscle and fur-

Figure 1. Ultrasonographic finding during stress test in the rupture of the medial head of the gastrocnemius muscle.

Figure 2. Ultrasonographic finding of presence of the liquid collection in partial rupture of the medial head of the gastrocnemius muscle.

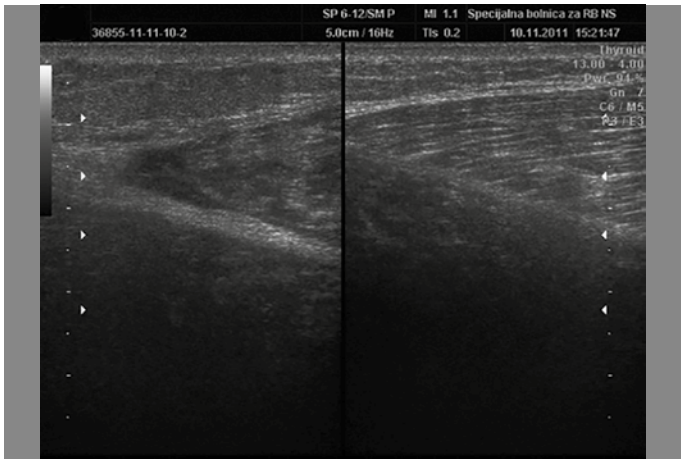

Figure 3. Comparative ultrasonographic finding of the patient with the rupture of the medial head of the gastrocnemius muscle (left) and healthy leg (right).

ther investigations were carried out. The mean age was 42.3±11.3 years. The left leg was involved in 30 cases and the right in 37 cases. We undertook 83 control US examinations in proposed time intervals of 15 days, during which the process of healing was verified together with the presence of sequels and liquid collection.

RESULTS

Initial examination discovered presence of liquid collection in 19 of the 67 examined patients and during control examinations we founded 6 newly formed liquid collections in patients without such previous finding. Liquid collection was present in 11 patients with total and 14 patients with partial rupture of the medial head of the gastrocnemius muscle.

In our study we examined 81 patients and found 6 cases of suspicious DVT out of which vascular surgeon confirmed 5 cases. In one case it was isolated DVT and in 4 cases it was combined with rupture of the medial head of the gastrocnemius muscle.

The results shown in Table 1 indicate that leading finding at patients with diagnose of "tennis leg" is partial or total rupture of medial head of gastrocnemius muscle. As shown in Table 2, partial ruptures were more often in ultrasonographic findings, compared to total ruptures. The most common causes of injury of patients who had rupture of medial head of gastrocnemius were recreational and daily activities (Table 3). Number of patients who appeared on control examinations proportionally decreased over time (Table 4). And Table 5 shows the results of control US examinations.

Table 1. Results of US examination of patients with clinical diagnosis of "tennis leg".

Type of lesion	No. of cases	(%)
Combined lesion of soleus and gastrocnemius muscles	1	1.23
Soleus muscle lesion	1	1.23
Isolated deep venous thrombosis	1	1.23
Plantaris muscle rupture	1	1.23
Baker cyst rupture	1	1.23
Lesion of proximal part of Achilles tendon	2	2.47
Lesion of lateral head of gastrocnemius muscle	2	2.47
Oedema of medial head of miotendinosus muscle without signs of evident rupture	2	2.47
Patients without evident positive US finding	3	3.7
Partial or total ruptures of medial head of gastrocnemius muscle	67	82.72
TOTAL	81	100

Table 2. Types of rupture registered by US in patients with rupture of medial head of gastrocnemius muscle.

Type of rupture	No. of cases	(%)
Total	18	26.87
Partial	49	73.13
TOTAL	67	100

Table 3. Causes of injury in patients with rupture of medial head of gastrocnemius muscle.

Causes of injury	No. of cases	(%)
Recreational activities	30	44.78
Daily activities	16	23.88
Profesional sport activities	5	7.46
Occupational trauma	4	5.97
Other	12	17.91
TOTAL	67	100

Table 4. Number of control examinations in patients with rupture of medial head of gastrocnemius muscle.

Type of examination	No. of cases	(%)
Preliminar examination	67	100
First control examination	49	73.13
Second control examination	23	46.94
Third control examination	11	47.83

Table 5. The results of control US examinations.

US finding	First control	Second control	Third control
Muscle fibrosis	9	5	6
Partial rupture	15	2	1
Liquid collection	22	5	2
Isolated oedema	5	1	-
Total rupture	2	1	-
Regular finding	17	14	2

Total number doesn´t comply with number of control examinations due to fact that in some patients was found more than one finding (i.e. presence of both total rupture and liquid collection).

DISCUSSION

The focus of this study was to examine the subjects with clinical signs of rupture of the medial head of gastrocnemius muscle using ultrasonography. According to data found in the literature the clinical entity of the rupture of the medial head of gastrocnemius muscle was addressed as different types of injuries of the myotendinous junction[9,10]. The "weak spot" of the muscle is the place where the muscle changes to tendon because this part is rich in fast-twitch fibers type II B[11]. In this study we found an incidence of 96.3% when the site of the lesion was at the predicted spot (78 cases out of the 81 examined patients) (Table 1). This finding is pointing out the need for US verification of injuries of the locomotor system in general and especially for the soft tissue lesions of the lower leg. In three cases patients were complaining on persistent pain that could be connected to other etiological problems which are impossible to detect via US examination (for example lumbar syndrome). On the other hand high sensitivity of the US machine that was used in the study enabled us to objectively detect and evaluate small lesions of myotendinous junction (<2mm) during stress test and classify them in the group of partial ruptures. Results of this study indicate that in patients with clinical signs of "tennis leg" the dominant US finding is partial or total rupture of the medial head of the gastrocnemius muscle (82.72%). Other clinical entities are only present in small numbers (Table 1). Few cases of the rupture of plantaris muscle are in accordance with the findings of Delgado et al.[12]. The ratio between partial and total ruptures of the medial head of the gastrocnemius muscle in our study (Table 2) is showing higher incidence of partial rupture (73.13%) like in the paper of Bianchi et al.[13] which is opposite to results presented by the group of the Korean researchers[14] who reported higher number of total ruptures.

According to the results of similar studies the "tennis leg" appear as an injury in middle aged persons[3] which was the case in our study too (42.3 ±11.3 years). The main reason of injury in our study was recreational sports where dynamic movements and sudden change of direction produce too much stress to the soft tissues of the locomotor system which is also reported by other researchers[7] (Table 3). An interesting finding was reported by Yilmaz et al.[15] where he pointed out that the common reason to such type of injury in Islamic population occurs during praying in the kneeling position.

Initial US examination was performed in the time frame which ranged from 3 to 14 days (5.3 days average) upon injury. It is not recommended to make US examination during first 24 hours when evaluating partial or total ruptures of the medial head of the gastrocnemius muscle because of the bleeding which interferes with the ultrasonographic view.

Liquid collections between the aponeurosis of gastrocnemius and soleus muscles were registered in 25 cases (30.8%). There was only one case of US verified isolated presence of liquid collection initially. Later this was recognized during control examinations as ruptured Baker cyst. Delgado et al.[12] also demonstrated that one third of his patients had liquid collection opposite to Kwak et al.[14] who presented that in his study 83% of all patients had liquid collection after rupture of medial head of the gastrocnemius muscle.

Liquid collection was verified in 25 cases out of 67 (37.3%) who had the diagnosis of the rupture of the medial head of the gastrocnemius muscle, initially in 19 cases and 6 more on control examinations. Patients with partial rupture had liquid collection in 14 cases and total rupture in 11 cases. If we analyze only these absolute numbers we could be mislead since there was 18 patients with total rupture out of which 11 had positive finding on liquid collection (61.1%). On the other hand in 49 patients with the diagnosis of partial rupture 14 had positive finding on liquid collection (28.6%). Although the sample is limited in numbers we can draw a conclusion that the appearance of liquid collection after the rupture of the medial head of the gastrocnemius muscle is in relation with the size and degree of the lesion.

Speaking of the size of the lesion, Kwak et al.[16] reported that the largest dimension of the liquid collection after injury in the gastrocnemius muscle was 125mm[16] while we found the collections sized up to 52mm. Previous research by the same group reported larger diameter of liquid collections[17]. In this study the longest presence of the liquid collection lasted 53 days.

Ultrasonographic imaging indicated that the liquid collection is most probably serous as it was proposed in the paper by Guillodo et al.[18]. Namely, it was explained that pseudocystic liquid formation is usually serous and is resorbed spontaneously, as it was the case in our study. According to the results of our study and our experience, as well as the current standpoint in scientific circles it is not necessary to perform surgical incision in case of presence of liquid collection in the ruptured muscle except in the case of compartment syndrome[6,19].

Deep venous thrombosis was found in 5 cases (1 isolated and 4 associated with rupture) out of 81 patients involved in the study with the diagnosis of "tennis leg" (6.2%). This diagnosis was verified via duplex scan imaging method performed by a vascular surgeon. In 67 cases of the rupture of the medial head of the gastrocnemius muscle 4 cases were confirmed (5.9%). Our finding was significantly lower compared to other authors among whom Delgado et al.[12] reported the highest (9.9%). It is possible that the smaller number of this complication in our study is due to the fact that we excluded from the research patients with positive earlier vascular findings. Other possible reason of fewer cases of DVT we found could be that our patients were sent directly to the vascular surgeon after initial clinical examination without US imaging.

After initial US examination 49 (73%) patients were invited for a control examination 15 days later (Table 4). Analyzing the results of the first control trial we have found that 33 patients (67.4%) (Table 5) did not fully recover. This is an important notion pointing out that the treatment should last longer than two weeks. The largest number of injuries that ended up with complete healing was verified after the second control US in 14 out of 23 patients (60.9%). In one case we found that the partial rupture which didn´t heal even after 46 days from injury, because the patients neglected the instructions given to them about the therapy. It is necessary to say that the patients were called to the control US examination in case if they had positive previous finding, so the number of control US examinations dropped over time (and few patients did not even come to the control probably due to the subjective feeling of recovery). We did not find signs of calcification in any of the cases, although it is reported to be a common complication after muscle trauma, especially in the quadriceps muscle[17]. Finding of fibrous reparatory processes in the tissue indicate the importance of proper physical treatment of rupture of the medial head of the gastrocnemius muscle. The significance of control examinations is not only to follow up the sanation process, but also for obtaining valid data about possibilities and time frame to return to activities prior to injury. This is especially important for professional athletes

and also for recreational ones up to a point since the modern dayly living demands high level of fitness and dynamic activities. Although the number of control US trials did not meet the initial aim, according to standard protocols, we can conclude that the number of complications in our group of patients is relatively low and that the applied therapy greatly helped with their recovery. According to the results of our research, the highest number of normalized US findings after rupture of the medial head of the gastrocnemius muscle happened in the time frame of 20 to 35 days after injury.

Limitation of this research is that the patients with the diagnosis of rupture of the medial head of the gastrocnemius muscle were not treated by the same physician. There was no data on the treating protocol and the conclusions could not be brought unanimously due to impact of different treating protocols. Also, none of the patients were hospitalized and all of them were treated conservatively. Kwak et al.[16] underlines in his paper that all of the patients with rupture of the medial head of the gastrocnemius muscle were hospitalized for one to four days. In our research we found that all patients were treated with different types of immobilization regardless of the type of lesion. Some patients were immobilized with cast (removed for every control examination), some with crutches, elastic bandage, stick or high heel. Such condition demands implementation of specific unified protocol for treating of the rupture of the medial head of the gastrocnemius muscle.

CONCLUSION

Ultrasonography is a leading imaging method for evaluation of soft tissue injuries of the calf. This method is available, comfortable for the patient and reproducible. Multiplanar approach enables precise diagnostics of the injuries of the calf with possibility of multiple trials over time which provides complete evaluation of the ruptured medial head of the gastrocnemius muscle.

The results of our research indicate that in the case of "tennis leg" dominant finding is partial rupture of the medial head of the gastrocnemius muscle which should be treated adequately. Presence of the interfascial liquid collection is present in high percentage in the case of total rupture of the medial head of the gastrocnemius muscle and, therefore, can be taken as an additional sign for this injury. Isolated deep venous thrombosis or associated with partial or total rupture of the medial head of the gastrocnemius muscle in our research was not present in high percentage as described in the literature, but it needs to be taken seriously.

Ultrasonography is highly valid in initial diagnostics, monitoring of healing, applied therapy and imaging of the sequela in the injured medial head of the gastrocnemius muscle.

All authors have declared there is not any potential conflct of interests concerning this article.

AUTHORS' CONTRIBUTIONS: Each author contributed individually and significantly to the development of the manuscript. DL (0000-0002-7506-7125)* was the main contributor in the drafting of the manuscript and he also performed ultrasonographic examinations of patients. DKJ (0000-0001-5739-3237)*, AK (0000-0001-9749-3224)* and MD (0000-0002-3170-6829)* underwent rehabilitation, followed patients and gathered clinical data. DS (0000-0003-0409-8650)* and VK (0000-0003-3670-546X)* evaluated the data of the statistical analysis and also performed the literature search. All of the authors made a review of the manuscript. All of them agree with everything stated in the manuscript and approve the final version of work for publishing. *ORCID (Open Researcher and Contributor ID).

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