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Tennis elbow: an ultrasonographic study in tennis players

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The findings of ultrasound examination at and around the lateral humeral epicondyle in 41 tennis players suffering from so called tennis elbow are reported. Ultrasound examinations were performed with a real time ultrasound machine. The tenderness and functional impairment of tennis elbow may be caused by several different lesions, at times appearing in association. Six ultrasonographic characteristics could be identified:

Enthesiopathy **The proximal part of the tendon was enlarged and there were echogenicity alterations.**
Tendonitis **The tendon of the extensor carpi radialis brevis was enlarged and areas of dyshomogeneous hypoechogenicity were evident with loss of the normal microscopic waveform structure of the tendon collagen.**
Peritendonitis **A thickening of the peritendonous lining was present.**
Bursitis **A bursa was located on the inferior surface of the tendon of the extensor carpi radialis brevis.**
Intramuscular haematoma **Some circular or ovoid hypoechogenic areas within the muscular substance of the extensor carpi radialis brevis were evident.**
Mixed lesions **These were not correlated with the intensity and the duration of the symptoms.**

Ultrasonographic examination gives a detailed iamge of the structures involved in the tennis elbow syndrome, confirms the diagnosis, and may be useful in monitoring treatment.

Keywords: Tennis elbow, sports injuries, ultrasonography

Introduction

The term 'tennis elbow' (TE) refers to a painful condition at or around the lateral epicondyle of the humerus and the common extensor origin. It may radiate along the forearm. There is also localized tenderness over these areas, and pain on resisted active extension of the wrist when the elbow is fully extended[1].

Although chronic overuse is said to cause lateral epicondylitis, its aetiology is still not well defined[2], and several factors have been proposed. Some authors have suggested that enthesiopathy may be the unifying cause[3], although several other lesions have been reported[4]. Some neurological syndromes, namely cervical spine disease with radiculopathy[5] and posterior interosseus nerve entrapment[6], may mimic the tennis elbow syndrome. Bursae have also been associated with TE[7].

The factors involved in the aetiology of tennis elbow have been widely discussed[8]. On a purely anatomical basis, they include detachment from the lateral epicondyle of muscular or tendinous fibres of the extensor carpi radialis brevis during wrist movements, and impingement of bursae or synovial folds between the fibres of the extensor carpi radialis brevis and the elbow joint capsule[9]. A blood flow disturbance, causing relative ischemia and degeneration of the soft tissues around the lateral epicondyle, has also been proposed as a possible cause[9].

Recent studies have shown that up to one third of American local league tennis players may suffer from tennis elbow[10]. Only a minority recover fully with medical treatment[11]. Causes indicate racquet factors, hitting technique, timing, and condition of the court. High frequency of play is the main contributory factor[10,11].

We report the findings of ultrasound examination in 41 tennis players suffering from TE.

Patients and methods

The series presented consists of 41 tennis players (24.3 ± 7.3 years, range 16 to 36 years), only two were female. All were experienced, training three to five times a week and competing at least at regional level in their respective age groups for the year before the study. They had all presented with pain on the lateral aspect of the lateral humeral epicondyle and/or the common extensor origin for an average of 2.2 months (range 17 days to 9.8 months) before the study. About one third (15) had already sought medical advice with no beneficial effect. Neurological involvement and rheumatic diseases had been excluded in all patients, and a definite diagnosis of TE was confirmed independently by both the orthopaedic surgeons involved in the study.

All ultrasound examinations were performed using a real time ultrasound machine, equipped with a

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linear 7 MHz probe, and a sector 5 MHz probe. Ultrasound scan was performed by one of the radiologists, ensuring that the scanning beam was perpendicular to the structures studied[12]. The analysis of the scan was made on images by two other radiologists who had no prior knowledge of the patient whose image they were examining.

Eight patients were followed up to complete clinical resolution.

Results

Analysis of the ultrasound scan images confirmed the multiplicity of lesions associated with this clinical syndrome.

Enthesiopathy (five cases) The proximal part of the extensor carpi radialis brevis (ECRB) tendon was enlarged and there were echogenicity alterations.

Tendonitis (15 cases) The main tendon of ECRP was enlarged and areas of dishomogeneous hypoechogenicity were evident together with loss of the normal waveform structure of the tendon (*Figure 1*).

Peritenonitis (four cases) A thickening of the peritendonous lining was present. In one case, this was accompanied by an enlargement of the tendon itself but it was still possible to identify its normal structure.

Bursitis (five cases) An ovoid, well defined, hypoechoich area, a bursa, was located on the inferior surface of the tendon of the extensor carpi radialis brevis. It displaces the tendon dorsally (*Figure 2*).

Intramuscular haematoma (two cases) Some circular or ovoid hypoechogenic areas within the muscular substance of the ECRB, of different echogenicity from the muscle and ill-defined borders, were evident about one centimetre from the extensor carpi radialis attachment (*Figure 3*).

Mixed lesions (seven cases) They were not correlated with the intensity and the duration of the symptoms.

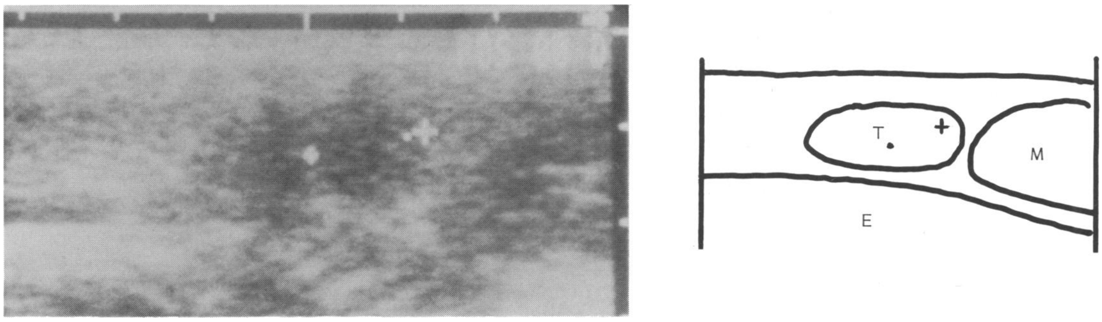

Figure 1. *Tendonitis* The tendon of the extensor carpi radialis brevis is enlarged and some areas of ultrasonic dyshomogeneity are present. The normal waveform structure is lost

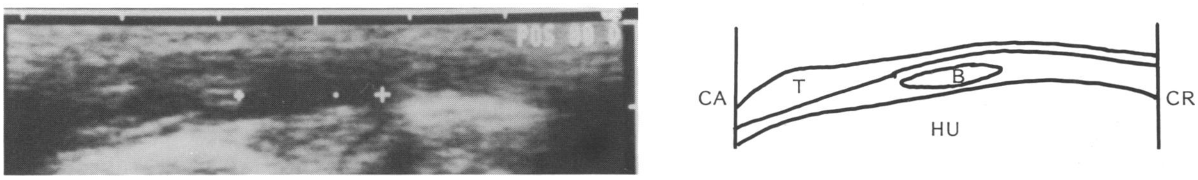

Figure 2. *Bursitis* A bursa is evident under the inferior aspect of the tendon of the extensor carpi radialis brevis, which is displaced dorsally

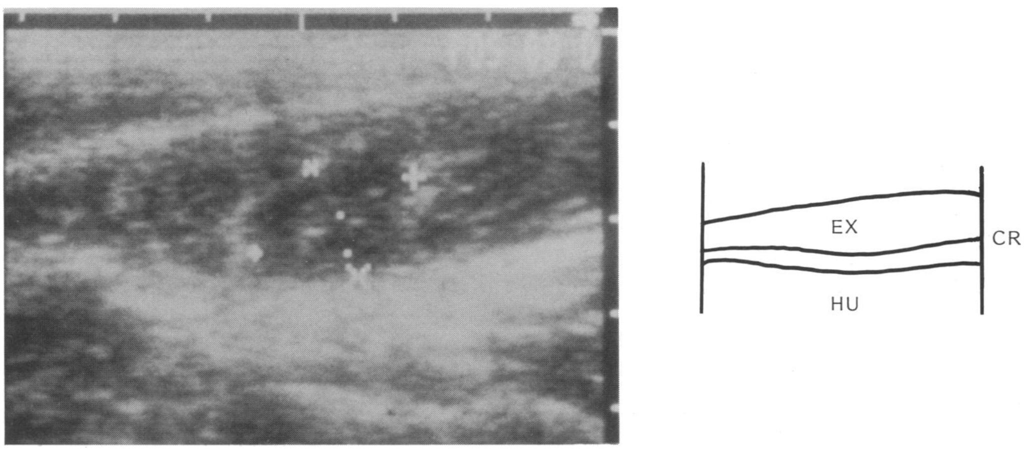

Figure 3. *Intramuscular haematoma* An ovoid area of hypoechogenic appearance, located within the muscular substance of the extensor carpi radialis brevis, about one centimetre from its attachment, is shown

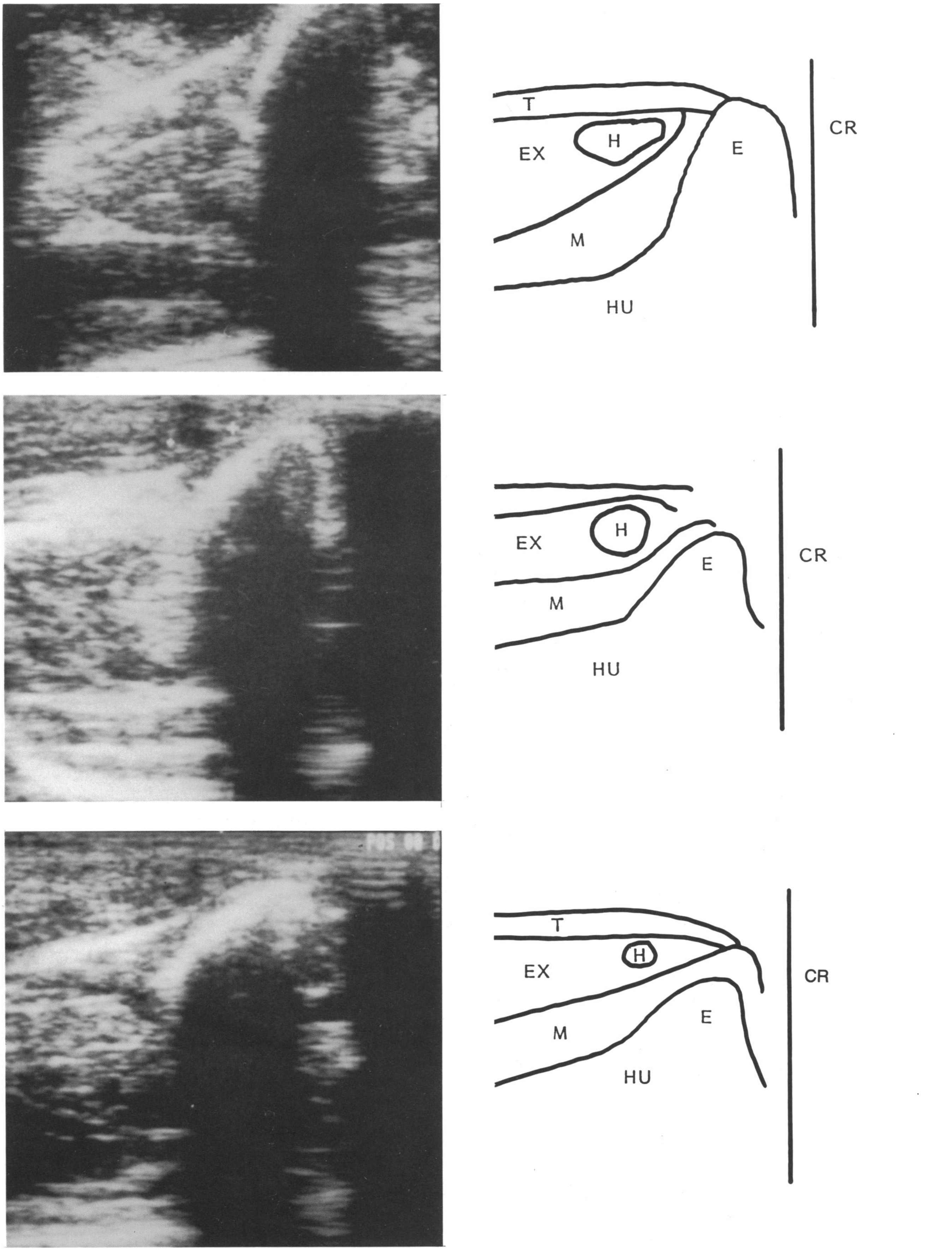

Figure 4. *Evolution of an intramuscular haematoma treated conservatively* Top: A Large ovoid hypoechoic mass is evident just distal to the musculo-tendinous junction. Middle: The mass is reduced in size after two months. Bottom: Four months after the first scan, there is still some ultrasonic evidence of the original intra-muscular haematoma, but the patient was fully asymptomatic

No ultrasonographic abnormalities (three cases) This may have been due either to the acuteness of the lesions or their mildness or technical factors causing them to be beyond the resolution of the scanner used.

In 14 cases the tendon of ECRB appeared as a distinct anatomical structure[9]. (Two patients with an ultrasonographic picture of enthesiopathy, six with tendonitis, two with peritendonitis, one with bursitis, two with mixed lesions and one with no detectable ultrasonographic alterations.)

Discussion

The common extensor origin is classically described as a tendinous mass[13]. However, in accordance with other studies[9], we found that the tendon of the extensor carpi radialis brevis could be a distinct structure. The fact that the surface of attachment is thus reduced may account for the decreased ability to sustain repeated stresses, and may thus be a predisposing factor for overuse injuries.

The pain evoked by movements and the localized tenderness can be explained by all the findings of this study. Typically, the symptoms are reproduced when the elbow is fully extended with the wrist dorsiflexed, and a downward force is applied on the middle finger with the patient resisting it[14], and in the last 20° of extension when the forearm is pronated and the wrist is extended from a fully flexed position[8]. In these forced movements, the muscle either compresses the underlying inflamed bursa, or, being incapable of further lengthening, muscle or tendon micro-tears are produced.

At present, it is difficult to know whether ultrasonographic findings can be used as a prognostic means. In cases of definite bursitis, local steroid infiltration was prescribed, while muscle tears were treated conservatively with rest, stretching, oral NSAIDs and ultrasound therapy.

Three cases of long-standing and recurrent TE with an ultrasound diagnosis of tendonitis were treated surgically with multiple incisions along the longitudinal axis of the tendon. One further case, ultrasonographically diagnosed as an enthesiopathy, was treated with percutaneous release of the epicondylar muscle origin[15] with full recovery. All the patients operated on are currently playing and regard themselves as fully healed.

Up to now, it is unclear how ultrasonographic findings may influence the management of TE, but a tentative classification of the underlying anatomical basis of the condition may be attempted.

Key to illustrations

B, bursa; CA, caudal; CR, cranial; E, lateral humeral epicondyle; EX, extensor carpi radialis brevis; H, haematoma; HU, humerus; M, other muscles; T, tendon of the extensor carpi radialis brevis, or common extensor muscles tendinous mass

Extra-tendinous alterations

Muscular tears Haematoma of circular or ovoid appearance, hypoechogenic.

Bursitis Cavity lying just below the extensor carpi radialis brevis, adjacent to its radial head.

Pathology of the tendon[16]

Enthesiopathy Enlargement of the proximal part of the tendon and echogenicity alterations.

Tendonitis Enlargement and alterations of the substance of the tendon, possibly with inflammatory and degenerative appearances.

Peritendonitis Thickening of the tendon sheath all the way to the area of the muscle-tendon junction. A stenosing tenosynovitis may result[17].

Mixed lesions Any combination of the above mentioned pathologies may, at least theoretically, occur.

Until recently, although it was recognised that the variable sites of local tenderness could imply different pathology[1], tennis elbow was considered a single entity[2]. To our knowledge, this is the first *in vivo* study to show non-surgically that TE may be caused by several different pathological lesions.

Ultrasonographic examination gives a detailed image of the structures involved in the tennis elbow syndrome, confirms the diagnosis, and may be useful in monitoring treatment (*Figure* 4). Due to its safety, its contained costs, and the easiness of the scan itself, we believe that ultrasonography can become routine practice in the assessment of TE.

However, a potential limitation of the technique is the availability of high quality transducers, given that the axial resolving power of a 7.5 MHz transducer is around five mm. In our hands, this has allowed us to detect intramuscular haematomas of about two mm in diameter, and to study tendinous lesions in detail[18], being able to follow the evolution of post-traumatic haematoma in ruptured tendons[19], and the image of single-thread suture in repaired tendons[20].

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