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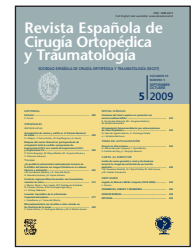

CASE REPORT

Carpal tunnel syndrome in patients with a bifid median nerve

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KEYWORDS
Median nerve;
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Abstract
Introduction: The most frequent type of entrapment neuropathy is carpal tunnel syndrome. Diagnosis is often clinical and electromyographic. Ultrasound studies not only permit diagnosis through the detection of median nerve morphological changes but also make it possible to identify potential anatomic abnormalities prior to decompressive surgery, thus constituting an invaluable tool for the surgeon who can in this way obtain better results.
Case reports: We present 4 cases of a bifid median nerve diagnosed preoperatively by means of ultrasound and we evaluated this finding taking into account the patients' clinical specificities and the good surgical outcome, with previous knowledge of the anatomy and decompression of both branches.
Conclusions: The existence of this abnormality and other possible intra-canal pathologies make us prefer open approaches to the carpal tunnel over endoscopic surgery, if genuine resolution of the condition is to be achieved.
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PALABRAS CLAVE
Nervio mediano;
Nervio mediano bífido;
Descompresión;
Ecografía

Síndrome del túnel carpiano en pacientes con nervio mediano bífido

Resumen
Introducción: La neuropatía por atrapamiento más frecuente es el síndrome del túnel del carpo. De diagnóstico habitualmente clínico y electromiográfico, los estudios realizados mediante ecografía, además de permitir el diagnóstico por la detección de cambios morfológicos típicos en el nervio mediano, logran identificar posibles anomalías anatómicas previamente a la cirugía de descompresión, lo que supone una inestimable ayuda al cirujano y augura mejores resultados.

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Casos clínicos: Presentamos cuatro casos clínicos de nervio mediano b›´fido diagnosticados prequirúrgicamente mediante estudio ecográfico, y valoramos este hallazgo con las peculiaridades clínicas de los pacientes, así como el buen resultado quirúrgico, con el conocimiento previo de su anatomía y la descompresión de ambas ramas.
Conclusiones: La existencia de esta anomalía y otras posibles enfermedades intracanal orientan hacia la preferencia de los abordajes abiertos del túnel del carpo sobre la cirugía endoscópica, para conseguir la resolución de los cuadros clínicos.
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Introduction

Carpal tunnel syndrome (CTS), i.e. compression of the median nerve at the level of the carpal tunnel is the most frequent compressive neuropathy and it can on some occasions, albeit rarely, be seen in association with other anatomic anomalies of the said nerve. In 1977, Lanz[1] described the anatomic variants of the median nerve classifying them into 4 groups: *I)* variations in the course of the motor branch; *II)* accessory branches at the distal portion of the carpal tunnel; *III)* duplicated median nerve inside the carpal tunnel (proximal or high bifurcation, often associated with the presence of a median artery or an accessory muscle separating both branches[1,2]), and *IV)* proximal accessory branches proximal to the carpal tunnel.

Cases under group III in this classification are the ones most often associated with CTS[1]. The incidence of high bifurcation of median nerve was 2.8% in Lanz' series[1], and 3.3% in Amadio's[3].

Imaging techniques have proved helpful in the anatomic study of the carpal tunnel. Sonography, in particular, apart from making it possible to diagnose CTS by detecting typical morphological changes in the median nerve, permitted identification of potential anatomic anomalies.

We present 4 cases of CTS with a bifid median nerve diagnosed sonographically. On the basis of those cases and the studies reviewed, we argue for the need to systematically examine the carpal tunnel when carrying out the nerve decompression in order to prevent potential relapses.

Clinical cases

In the course of a prospective study intended to compare electromyographic and sonographic results in CTS, we evaluated 67 wrists in 41 patients, using a Somatom system (Siemens® Medical Solutions, Mountain View, CA) with a multi-frequency linear probe. Four cases of a bifid median nerve were reported as an incidental finding.

Case 1

Seventy-one-year old woman with a 2-year history of right-sided brachialgia associated to paresthesias, specifically in the thumb and the index finger. Symptoms intensified during the night, when the felt a marked loss of force in the right upper limb. Tinel's test was positive while Phalen's test was negative. Electromyographic analysis confirmed compression of the median nerve in the carpal tunnel. A sonographic study of the carpal tunnel showed a bifid median nerve with a radial and an ulnar branch, with an anteroposterior diameter of 2 and 1.8 mm, respectively, and a cross-sectional area in the proximal portion of the tunnel of 0.04 and 0.02 cm^2, respectively. Each one of the branches appears abnormally hypoechoic with respect to the normal fascicular pattern. Sonographically, no bifid median nerve was observed on the contralateral side.

Case 2

Fifty-two-year old woman who presented with a 2-year history of paresthesias in the right hand. Symptoms affected the index and middle fingers and the radial half of the ring finger. The patient complained of brachialgia and weakness in the right upper limb. Tinel's sign was clearly positive. Phalen's test was positive at 15 degrees approximately. An electromyographic study confirmed a diagnosis of CTS. A carpal sonography was performed, which revealed the presence of a bifurcated median nerve with anteroposterior diameters of 1.8 and 1.3 mm for the radial and ulnar branches, respectively, and cross-sectional areas of 0.04 and 0.02 cm^2, respectively. An echo-Doppler study identified a median artery between the 2 branches of the bifid nerve. A magnetic resonance (RM) and later decompressive surgery confirmed the sonographic findings. Sonographically there were no anomalies in the contralateral median nerve.

Case 3

Sixty-seven-year-old woman who presented with a 1-year history of paresthesia in the right hand. The paresthesia affected the index, middle and ring fingers. Electromyography confirmed a diagnosis of CTS. Sonography showed 2 nerve trunks of an anteroposterior diameter of 1.7 and 1.6 mm respectively, and a cross-sectional area of 0.03 cm^2 in the proximal portion of the tunnel in both branches. In this case, color Doppler and power Doppler studies revealed the presence of a persistent median artery between both trunks (fig. 1). An axial-slice MR study of the wrist displayed similar findings to those in the sonogram and confirmed the presence of a bifid median nerve, identified as 2 low-intensity oval structures, with a persistent median artery. Decompressive surgery confirmed the preceding studies and

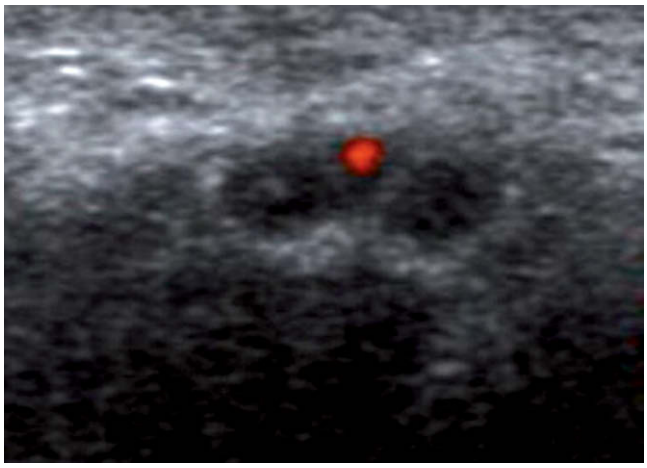

Figure 1 Echo-Doppler. Note the bifid median nerve and the median artery.

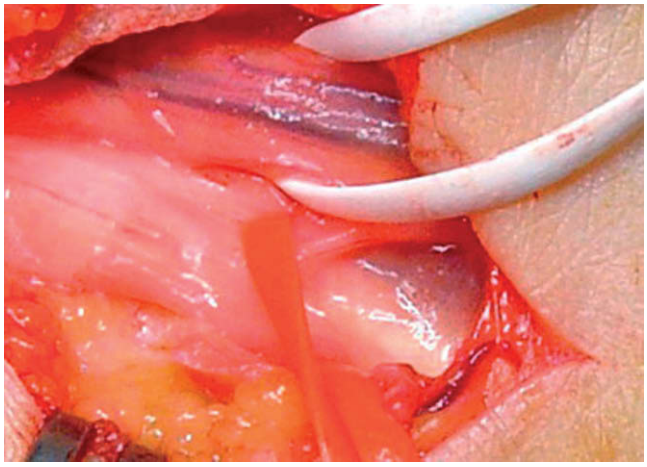

Figure 2 Surgical image of a bifid median nerve with a median artery.

allowed release of both branches. Sonography did not reveal a contralateral bifid median nerve.

Case 4

Forty-three-year-old male presenting with diffuse pain in the arm and hand, accompanied by paresthesias in the index and middle fingers of the left hand, numbness and weakness. Tinel's and Phalen's tests were positive. Nerve conduction velocity studies were positive for CTS. Sonography showed 2 nerve trunks with an anteroposterior diameter of 1.4 and 1.2 mm, respectively, as well as a cross-sectional area of 0.02 cm^2 in both branches. No median artery was identified between the nerve trunks. Once again, a diagnosis of bifid median nerve was established with MR and nerve decompression surgery. Sonographic study of the contralateral median nerve was normal.

In all cases, an extensive surgical incision was performed from a level 1 cm proximal to the palmar flexion crease of the wrist proximally to the proximal flexion crease of the hand (cephalic line), together with a careful release of the 2 trunks of the bifid nerve (fig. 2). Postoperatively, all symptoms disappeared completely.

Discussion

The median nerve does not usually give off any branches during its course in the lower third of the forearm and wrist, with the exception of an inconstant palmar cutaneous branch. After its course below the anterior carpal ligament, the nerve enters the palm of the hand. The recurrent motor branch may originate at several points along the nerve's course. Subsequently, the median nerve divides into the digital nerves, which provide sensation to the first, second and third digits and to the radial half of the fourth.

In 1969, Kessler for the first time described a case in which the median nerve was bifurcated into 2 branches from the middle and the distal third of the forearm[4]. Years later, Lanz described the anatomic variants of median nerve bifurcation[1].

This paper focuses on group III in the Lanz classification: cases with a duplicated median nerve inside the carpal tunnel (proximal or high bifurcation). Within this group there are several variants. For example, Amadio, and Szabo and Petty described, in 2 different publications, a rare variant in which an isolated compartment within the carpal tunnel contained one half of a bifid median nerve[3,5]. But the entity most often associated with a bifid median nerve is a persistent median artery. Approximately 10-30% of wrists present with a persistent median artery, but in some populations such arteries may appear in up to 50% of individuals. The anomaly may be bilateral, and the artery may extend until the superficial palmar arch or, less commonly, irrigate only the thumb and index finger. A persistent median artery is normally asymptomatic, but thrombi could develop and cause a carpal tunnel syndrome or digit ischemia. Finding a bifid median nerve in the absence of a median artery is even less common[4].

Another anomaly is for the medial nerve to be split and compressed by an abhorrent, duplicated, hypertrophied or digastric muscle[6].

A review of the literature reveals that the distribution of sensitivity in patients with a bifid median nerve is not constant. However, in the majority of cases, the radial trunk divides into a motor branch and sensory branches for the thumb, index finger and the radial half of the middle finger, whereas the ulnar trunk only sensitizes the third interdigital space[7]. The existence of these variants must be considered since compression of each branch may produce different symptoms in different patients[4].

Sonographically, a median nerve cross sectional area larger than 0.09 or 0.10 cm^2, measured at the level of the pisiform bone, is considered diagnostic of CTS. However, patients with a bifid median nerve diagnosed clinically and electromyographically with CTS, have also shown normal cross sectional areas for each branch. Therefore further studies are necessary to determine if size of the cross-sectional area of the nerve, measured sonographically in CTS, can be used as a valid criterion in cases of a bifid median nerve[8].

Ianacelli et al[9] report 6 cases of bifid median nerve diagnosed sonographically. In 4 of these cases, the 2 branches were of the same size: In 2 of these, cross-sectional areas were smaller than normal (0.04–0.05 cm^2) and in the other 2 they were larger than normal (0.09–0.10 cm^2). In the other 2 cases, one branch was larger than the other[9].

This report presents 4 patients with CTS associated to a bifid median nerve, which account for 2.68% of the 67 wrists with CTS that were studied sonographically. In 2 of these the duplicated nerve is associated to the presence of a persistent median artery that separates both nerves. In the other 2 cases, the bifid median nerve is not related to the median artery and its 2 branches run parallel to each other inside the carpal tunnel. In all cases, the sonographic diagnosis was confirmed by MR and decompression surgery. All 4 cases were unilateral.

In 3 of the cases presented herein, the cross-sectional area is identical in both branches, with only one case showing a small difference.

To conclude, there are studies in the literature that indicate that 11% of patients with CTS show some anomaly in the carpal tunnel[10], which justifies the obligation of inspecting the tunnel. The use of endoscopic surgery in these cases could lead to an unnecessary increase in the percentage of relapses[5,10]. Instead, a short palmar approach can be used to subsequently place the wrist and fingers in hyperextension to visualize the whole of the carpal tunnel. The presence of an isolated branch of the bifid median in a separated compartment may result in relapse of CTS if it is not detected in previous complementary studies such as sonography, or during carpal tunnel review at decompression surgery.

Conflict of interests

The authors have declared that they have no conflict of interests.

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