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Review article

Bilateral carpal tunnel syndrome – A review

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ABSTRACT

Carpal tunnel syndrome (CTS) is the most common upper extremity compressive neuropathy, with a prevalence of 3%–5% in the general population, and 6% in the group of females over the age of 40. It occurs about five times more common in females, with 2 peaks observed, in the 6th and 8th decades of life. Bilateral manifestation is more common than unilateral (60%), but significantly more often begins or is more strongly expressed in the dominant hand. Possible anatomical abnormalities underlying the development of CTS account for about 5% of cases. More and more scientific data confirm the significant role of central nervous system processes (including central sensitization) in the development of carpal tunnel syndrome, and changes in central nervous system body somatotopic representation, resulting from prolonged median nerve pathology, are described in consistence with the brain plasticity concept. This central involvement of bilateral CTS may explain that a proportion of patients following surgery for one hand experience improvement also in the non-operated hand.

1. Introduction

Carpal tunnel syndrome (CTS) is the most common upper extremity compressive neuropathy, with a prevalence of 3%–5% in the general population, and 6% in the group of females over the age of 40 [1]. Women suffer 4–5 times more often than men. Age distribution is bimodal with peak morbidity at the age of between 50 and 59, and over 80 [2,3]. CTS can occur in one or both hands, although bilateral manifestation is much more frequent. Bilateral symptoms of CTS are reported to occur in 22%–87% of patients, with most studies citing a rate of approximately 60% [4].

The unilateral or bilateral compressive neuropathy of the median nerve in the carpal tunnel has been the subject of much scientific research. The presence of these two forms of disease can be influenced by many factors, both peripheral and central, related to processes occurring within the central nervous system. The objective of this review was to determine several factors associated with bilateral manifestation of CTS: clinical characteristics of patients, possible involvement of central nervous system, causes of this manifestation and outcomes of surgery for bilateral CTS.

1.1. General clinical characteristics of patients with bilateral CTS

Bilateral CTS is approximately four times more common in females than in men, more commonly in people with body mass index over 29 and within the age range of 45–65 [5].

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The occurrence of CTS symptoms bilaterally correlates positively with the duration of the condition [6,7]. The condition is more common in the dominant hand of both right- and left-handed people [8,9]. Left-sidedness is associated with a 13-fold increase in the risk of left-side syndrome, whereas in right-handed individuals, the occurrence of right-side syndrome is five times more frequent [5]. Primary or more intensive manifestation of bilateral CTS in a majority of cases is in the dominant hand. Right-sided CTS occurs more frequently in young and female patients [5,10]. Earlier onset of symptoms on the dominant side and their increased severity are explained by the greater use of the dominant hand. The exception may be those who, as a child, learned to use a non-dominant hand in manual operations [8,11].

In nearly one-half patients with unilateral CTS, conduction abnormalities are found in contralateral median nerve electrophysiological studies despite absence of clinical signs. In most of them, the syndrome develops in the other hand in the following months or years [4,12]. Bagatur et al. analyzed a group of 131 patients after unilateral CTS surgery with a diagnosis of 66% of median nerve conduction abnormalities in the second (healthy) hand; in 73% of patients, clinical symptoms of the syndrome developed over time [7]. Electrophysiological studies have not confirmed asymmetry of nerve sensitivity thresholds with respect to the dominant hand, which could theoretically make the dominant hand more susceptible to agents causing disease symptoms [12,13].

1.2. *''Sensitization'' in the central nervous system* (central sensitization)

The effect of unilateral peripheral nerve impairment on neurological manifestations on the opposite side is relatively well documented in experimental studies. Changes to the healthy nerve in the other limb are qualitatively similar to those found in the injured nerve limb, but are less severe and last less long. It is unclear whether this is a secondary phenomenon or a specific biological target, but the occurrence of such effects indicates the presence of complex signalling mechanisms that connect both sides of body, in particular signalling via the system of commissural interneurons that is present in the spinal cord and brainstem. More evidence is emerging indicating the role of central nervous system processes in CTS. Zanette et al. noted that one third of patients with carpal tunnel syndrome complains of symptoms in those parts of the hand outside the median nerve region, while another 1/3 report symptoms proximal to the carpal tunnel [14]. Tucker et al. reported bilateral widespread elevation of vibration thresholds in individuals with median nerve neuropathy, indicating more somatosensory disorders than isolated peripheral mononeuropathy [15].

Other authors have investigated sensitivity thresholds of patients with unilateral carpal tunnel syndrome and in healthy individuals, finding bilateral hypersensitization in patients with CTS. The authors explain this phenomenon by a process of central ''sensitization'' in the central nervous system. The degree of lowering the sensory threshold of touch in the healthy limb correlated significantly with the duration of symptoms and severity of pain [16]. In a similar study, decreased bilateral pain thresholds for thermal stimuli were observed in patients with unilateral CTS. Changing the threshold of heat pain correlated negatively, whereas cold pain correlated positively regarding severity of pain and duration of symptoms. These disturbances were not accompanied by a change in ability to distinguish temperature changes [17]. The same authors observed a significantly weaker pinch-grip in both hands (as compared to the average in the population) in a group of women with unilateral CTS [18]. Schmid et al. evaluated the ability to distinguish between body sides by presentation of hands and feet symbols and specific Shepard–Metzler figures. In patients with unilateral CTS, impairment of hand image recognition was observed, with proper identification of foot images or spatial geometric figures [19]. A similar selective impairment of body part recognition was described in patients with diseases in which the role of central mechanisms is broadly accepted as Sudeck syndrome or limb amputation phantom pain.

1.3. *Topographic reorganization of the body image in the central nervous system*

Topographic reorganization of the body schema in the central nervous system within sensory and motor cerebral structures at the level of primary cortical centres observed in carpal tunnel syndrome may explain the limitation in the ability to identify the image of the afflicted site [19]. This phenomenon was studied with the help of functional magnetic resonance imaging (MRI), where asymmetrical distortion of body diagram in posterior areas of parietal cortex was observed in patients with unilateral CTS on the side opposite to afflicted limb.

There were no differences in the extent of these distortions with respect to the dominant hand [20]. Fornander et al. analyzed the effect of traumatic median nerve damage at carpal level on spatial activation of the primary cortical centres in functional MRI. Compared to the healthy control group, patients who had median nerve damage presented a more intensive activation of the cerebral cortex on the afflicted side. The increase in activity of primary cerebral cortical centres is associated with interhemispheric inhibition connected with afferent impulsation in the primary cortex on the opposite side [21]. In carpal tunnel syndrome, where paraesthesia is the dominant symptom, MRI observed pre- and postcentral gyri cortex thinning on the side opposite to the afflicted hand. This phenomenon does not occur in those forms of the syndrome where the dominant symptom is pain.

Thickness of the precentral gyrus is inversely proportional to the severity of paraesthesia. The dominance of paraesthesia in the clinical picture is also positively correlated with lower velocities of median nerve conduction [22]. In view of these observations, it is suggested that in the groups of patients with neuropathic compression of the median nerve with predominant pain and paraesthesia, the processes of conduction and transmission of pain and CNS sensation are carried out by slightly different mechanisms. Probably, the distortion of cortical representation by shifting nerve region by the median nerve is a brain defence response that allows sensory perception despite the absence or weakening of the peripheral impulsation due to nerve damage [23].

Similar somatotopic reorganizations are observed in the total absence of afferent impulsation at amputation, temporal pharmacological analgesia, or partial functional impairment,