

# CARPAL TUNNEL SYNDROME AND MANUAL MILKING

## Nerve conduction studies in 43 cases

João Aris Kouyoumdjian<sup>1</sup>, Rogério Gayer Machado de Araújo<sup>2</sup>

**ABSTRACT** - From 1989 to 2004, 3125 consecutive patients had electrodiagnosis of carpal tunnel syndrome (CTS); from these 43 cases (1.38%) were associated to manual milking; mean age was 44.9 years and 88.4% were male. The mean time in the milking profession was 247 months; the mean daily milking time was 146 minutes; symptoms referred at electrodiagnostic consultation had lasted on average 34 months, 83% were bilateral. The median sensory nerve conduction study was abnormal in 75.6% to the right and 66.7% to the left hand. The median nerve motor distal latency (MDL) was abnormal in 92.1% to the right and in 80.0% to the left hand. There were no differences between right and left for all electrophysiological parameters. In CTS related to manual milking most cases were men, with the MDL more affected than the sensory distal latencies and the electrophysiological abnormalities were found to be symmetric. Manual milking could be a natural model for occupational CTS. In contrast to idiopathic CTS, there was a greater involvement of motor fascicles; this finding is remarkable for CTS.

**KEY WORDS:** carpal tunnel syndrome, median nerve, compressive neuropathy, manual milking.

### **Síndrome do túnel do carpo e ordenha: estudo de condução nervosa em 43 casos**

**RESUMO** - No período de 1989 a 2004 foram diagnosticados por meio de eletroneuromiografia 3125 casos consecutivos de Síndrome do túnel do carpo (STC) e destes, 43 (1,38%) estavam associados com ordenha; a média de idade foi 44,9 anos e 88,4% eram do sexo masculino. O tempo médio de atividade profissional era 247 meses; o tempo médio de ordenha diária era 146 minutos; a sintomatologia referida na consulta eletrodiagnóstica tinha em média 34 meses de duração e 83% a referiam bilateralmente. O estudo da condução sensitiva do nervo mediano estava anormal em 75,6% na mão direita e em 66,7% da mão esquerda. A latência distal motora (LDM) do nervo mediano estava anormal em 92,1% à direita e em 80% à esquerda. Não havia diferença significativa dos parâmetros eletrofisiológicos entre os lados direito e esquerdo. Na STC associada a ordenha, a maioria dos casos é de homens, a LDM está mais afetada que as latências distais sensitivas e as anormalidades eletrofisiológicas são simétricas. A ordenha poderia ser considerada um modelo para STC ocupacional e diferente da STC idiopática, há maior envolvimento dos fascículos motores.

**PALAVRAS-CHAVE:** síndrome do túnel do carpo, nervo mediano, neuropatia compressiva, ordenha.

Carpal tunnel syndrome (CTS) is the most common entrapment neuropathy in humans<sup>1</sup>. Median nerve is compressed as it passes through the carpal tunnel together with nine flexor tendons, about 2 cm distal to the distal wrist groove<sup>2</sup>. The incidence was first described in Rochester, Minnesota (1961-1980); in women it is about 149:100000 and in men 52:100000<sup>3</sup>. In 1998, the incidence was described as almost four times greater in Marshfield, an area in Wisconsin<sup>4</sup> and more recently in Siena, Italy (1991-1998), where it was as high as 506:100000 for women

and 139:100000 for men<sup>5</sup>. The prevalence of diagnosed CTS, adjusted for age was found to be 3.4% for women and 0.6% for men in Maastricht, the Netherlands<sup>6</sup>; the prevalence of non-diagnosed CTS in an adult female population was found to be 5.8%, thus totalizing almost 10%. CTS was more frequently found in women between 40 to 60 years old and, in spite of the relationship to personal and occupational factors and to underlying systemic diseases, most of the cases are idiopathic. Nerve conduction studies are the gold-standard method for CTS diagnosis,

Laboratório de Investigação Neuromuscular, Serviço de Doenças Neuromusculares e Eletroneuromiografia, Departamento de Ciências Neurológicas, Faculdade de Medicina de São José do Rio Preto, SP, Brazil (FAMERP); <sup>1</sup>Professor-Adjunto; <sup>2</sup>Pós-graduando.

Received 16 January 2006, received in final form 13 April 2006. Accepted 1 June 2006.

Dr. João Aris Kouyoumdjian - Rua Luiz Antônio da Silveira 1661 - 15025-020 São José do Rio Preto SP - Brasil. E-mail jaris@terra.com.br

usually showing prolonged distal latencies of the median nerve<sup>7-9</sup>.

Carpal tunnel syndrome related to occupational factors has been a disputed theme due to its elevated incidence in a general population regardless the kind of activity. There is strong evidence that work involving repetitive and strenuous use of the wrist and hand contributes to the development of musculoskeletal strain injuries and to CTS<sup>10</sup>. Personal characteristics as risk factors for CTS development seem to be more important than occupational. Age, gender, weight (body mass index) and wrist dimension have been well described to act independently as risk factors<sup>11</sup>. The National Institute for Occupational Safety and Health Review of epidemiology studies on occupational CTS concluded that there was evidence of positive associations between highly repetitive work, forceful work, or exposure to vibration and the development of CTS<sup>12</sup>. There was insufficient evidence to associate specific postures or hand or wrist positions to the development of CTS. There was strong evidence to combine factors such as force and repetition or force and posture associated with the development of CTS<sup>12</sup>.

Manual milking represents a major and very specific risk factor mainly in countries where milking machines are not yet in common use. We did not find large series of individuals with CTS related to manual milking so the aim of this study was to report on 43 cases with nerve conduction studies. When compared to idiopathic CTS, cases related to manual milking revealed some important differences. We believed that this could serve as a model to a better understanding of the pathophysiology of this compressive neuropathy.

## METHOD

**Subjects** – Forty-three patients with electrodiagnosis of CTS related to manual milking were selected out of 3125 consecutive cases of CTS from 1989 to 2004. They represented 1.38% of total CTS electrodiagnoses. Thirty-eight were men (88.4%) and 5 were women (11.6%) with a mean age of 44.9±10.2 years (22 to 66). In contrast, of the non-

milk CTS cases 2,673 were women (86.7%) and 409 were men (13.3%) with a mean age of 49.3±12.4 years (17 to 93).

**Procedure** – Electrophysiological parameters for CTS diagnosis were based on median nerve sensory distal latency (SDL), onset-measured,  $\geq 3.0$  ms or conduction velocity  $\leq 46.6$  m/s with a wrist to index finger distance of 14 cm and median nerve motor distal latency  $\geq 4.25$  ms with a wrist to *abductor pollicis brevis* (APB) of 8 cm. In 2 cases, median palm to wrist mixed peak latency  $\geq 2.30$  ms and sensory median-ulnar latency difference to ring finger  $\geq 0.50$  ms was used. All cases had numbness, paresthesia and pain at night and in the early morning and also during manual milking. Polyneuropathy was excluded both clinically and by normal sensory and motor ulnar nerve conduction studies. Mid-palmar temperature was kept at  $\geq 32.0^\circ\text{C}$ .

**Statistical analysis** – The data analysis used the Student's t-test to compare means of electrophysiological parameters between right and left hands. Statistical significance was set at a p-value  $< 0.05$ .

## RESULTS

The mean time working in the milking profession in 33 cases was 247±156 months (range: 2-600); the mean daily milking time obtained in 28 cases was 146±101 minutes (range: 40-420); the mean duration of symptomatology was 34±42 months (range: 1-144); 83.3% had bilateral symptoms, 12.5% only of the right and 4.2% only of the left hand. Nerve conduction studies were bilaterally abnormal in 69.8%, 18.6% of right and 11.6% of left hand. The median sensory nerve conduction study (NCS), wrist to index finger, was abnormal (CV  $\leq 46.6$  m/s) in 75.6% of the right and 66.7% of the left hand. Sensory median action potentials were not obtainable in 2 right hands and 1 left hand. The median motor distal latency (MDL), wrist to APB, was abnormal in 92.1% of the right and in 80.0% of the left hand (MDL  $\geq 4.25$  ms, 8 cm); there was no difference between right and left latencies. Compound action muscular potentials were recordable in all cases. Right and left electrophysiological parameters as well the statistically significant differences are shown on Table.

Table. Results of median nerve electrophysiological parameters.

	Right	n	Left	n	p-value
SDL (wrist to index, 14 cm)	3.66±0.43 ms	31	3.65±0.55 ms	31	0.9367
SNAP amplitude (wrist to index, 14 cm)	10.48±5.20 $\mu\text{V}$	31	13.12±9.10 $\mu\text{V}$	31	0.1659
MDL (wrist to APB, 8 cm)	5.28±0.81 ms	37	5.26±0.88 ms	32	0.9220

ms, milliseconds;  $\mu\text{V}$ , microvolt; n, number; SDL, sensory distal latency; SNAP, sensory nerve action potential; MDL, motor distal latency; APB, abductor pollicis brevis.

## DISCUSSION

Although there are several reports of the association of CTS and occupation, the relationship between manual milking and CTS nerve conduction parameters has not been described. Stal et al.<sup>13</sup> described that high values of dorsiflexion and radial deviation as well as increased velocity and repetitiveness might induce an increased risk of CTS in females working with machine milking. Various epidemiologic studies use different research definitions of CTS. Subtle abnormalities of median nerve conduction can frequently be detected in workers, whether or not they use their hands for heavy or repetitive work. Because median nerve conduction abnormalities can be asymptomatic, these observations do not determine whether certain activities can cause CTS<sup>14</sup>.

Despite widespread recognition of the relationship between hand and wrist use and symptoms of CTS, some authors still debate whether activities are a cause of the basic pathology of the syndrome<sup>14</sup>. Davis et al.<sup>10</sup> emphasized that work related to CTS is a significant public health problem and, physician-reported cases were more likely male and employed in manufacturing. Some debate exists related to CTS, gender and occupation. Some believe that women with CTS are more likely to work in moderate manual work and men with CTS are more likely to work in heavy office/clerical work<sup>15</sup>. However, McDiarmid et al.<sup>16</sup> argue that men and women doing the same work tasks will have similar rates of CTS, and, particularly in manual milking this was true, even though most milkers are men.

Manual milking involves the continuous and powerful use of finger flexor muscles, alternating from right to left hand. In our cases it occurred during more than 10 years with a mean time of about 2 and a half hours daily. Subjects usually did not have complaints at the beginning of the milking activity since the mean symptomatology referred at the electrodiagnostic consultation was about 2 and a half years. The prolonged use of finger flexors at the same intensity and equally in right and left hands corresponded to the findings on nerve conduction parameters. There were no statistical differences among median sensory distal latencies, median sensory nerve action potentials amplitudes and median distal motor latencies. These findings were due probably by nonspecific flexor tenosynovitis affecting synchronically all the finger flexor tendons, a model that could be hard to find in idiopathic CTS. In this situation patients do not use the hands in strenuous and synchronous daily activities.

Another striking and unusual electrophysiological finding when compared to idiopathic CTS was the predominant MDL abnormality instead of SDL: 92.1% versus 75.6% of the right and 78.9% versus 73.2% of the left hand. There was a distinctly different pattern of involvement of all fascicles of the median nerve not sparing the motor fascicles as in some mild idiopathic CTS<sup>17</sup>. One hypothesis is that in CTS related to manual milking, median nerve fascicles are equally involved because there is nonspecific flexor tenosynovitis of all finger flexor tendons. In contrast, in idiopathic CTS the involvement of sensory more than motor fascicles could be due to a more selective nonspecific tenosynovitis. On the other hand, we can not exclude a gender bias with the predominance of men in CTS related to manual milking (87.8%).

We conclude that manual milking could be considered a natural model for occupational related CTS.

## REFERENCES

1. Dawson DM, Hallett M, Millender LH. Entrapment neuropathies, 2<sup>nd</sup> Ed. Boston: Little, Brown and Company, 1990.
2. Hennessey WJ, Kuhlman KA. The anatomy, symptoms, and signs of carpal tunnel syndrome. In Johnson EW (ed). Physical medicine and rehabilitation. Philadelphia: W.B. Saunders Company, 1997:439-457.
3. Stevens JC, Sun S, Beard CM, O'Fallon WM, Kurland LT. Carpal tunnel syndrome in Rochester, Minnesota, 1961 to 1980. *Neurology* 1988;38:134-138.
4. Nordstrom DL, DeStefano F, Vierkant RA, Layde PM. Incidence of diagnosed carpal tunnel syndrome in a general population. *Epidemiology* 1998;9:342-345.
5. Mondelli M, Giannini F, Giacchi M. Carpal tunnel syndrome incidence in a general population. *Neurology* 2002;58:289-294.
6. De Krom MC, Knipschild PG, Kester AD, Thijs CT, Boekkoi PF, Spaans F. Carpal tunnel syndrome: prevalence in the general populations. *J Clin Epidemiol* 1992;45:373-376.
7. Jablecki CK, Andary MT, Floeter MK, et al. Second AAEM literature review of the usefulness of nerve conduction studies and needle electromyography for the evaluation of patients with carpal tunnel syndrome. *Muscle Nerve* 2002;26(Suppl):S1-S53.
8. Ross MA, Kimura J. AAEM Case report #2: the carpal tunnel syndrome. *Muscle Nerve* 1995; 18:567-573.
9. Stevens JC. AAEM minimonograph #26: the electrodiagnosis of carpal tunnel syndrome. American Association of Electrodiagnostic Medicine. *Muscle Nerve* 1997;20:1477-1486.
10. Davis L, Wellman H, Punnett L. Surveillance of work-related carpal tunnel syndrome in Massachusetts, 1992-1997: a report from the Massachusetts Sentinel Event Notification System for Occupational Risks (SENSOR). *Am J Ind Med* 2001;39:58-71.
11. Kouyoumdjian JA, Zanetta DMT, Morita MPA. Evaluation of age, body mass index, and wrist index as risk factors for carpal tunnel syndrome severity. *Muscle Nerve* 2002;25:93-97.
12. Bernard BP. Musculoskeletal disorders and workplace factors. Cincinnati: National Institute of Occupational Safety and Health, 1997.
13. Stal M, Hansson GA, Moritz U. Wrist positions and movements as possible risk factors during machine milking. *Appl Ergon* 1999;30:527-33.
14. Rosenbaum RB, Ochoa JL. Carpal tunnel syndrome and other disorders of the median nerve. 2<sup>nd</sup> ed. Woburn: Butterworth-Heinemann, Elsevier Science, 2002.
15. Lam N, Thurston A. Association of obesity, gender, age and occupation with carpal tunnel syndrome. *Aust N Z J Surg* 1998;68:190-193.
16. McDiarmid M, Oliver M, Ruser J, Gucer P. Male and female rate differences in carpal tunnel syndrome injuries: personal attributes or job tasks? *Environ Res* 2000;83:23-32.
17. Stewart JD. Peripheral nerve fascicles: anatomy and clinical relevance. *Muscle Nerve* 2003;28:525-541.