

Demographic factors and medical conditions associated with CTS

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Abstract**Background**

Carpal tunnel syndrome (CTS) is the most common compressive neuropathy and the characteristic symptoms and signs occur following compression of the median nerve within the carpal tunnel. Usual symptoms include numbness, paresthesia and pain in the median nerve distribution. There exists some debates regarding the compression of median nerve in carpal tunnel, but it seems likely that abnormally high pressure in the tunnel exists in patients. This high pressure causes obstruction of venous flow, oedema formation and in long run; ischemia and damage to the nerve. CTS is associated with many different factors, which include demographic factors like square wrist, medical conditions like metabolic syndrome; diabetes; hypothyroidism and inflammatory arthropathies, pregnancy, genetic factors or occupation. The aim of this study is to evaluate the demographic factors and medical conditions associated with CTS in patients reporting to the Physical Medicine and Rehabilitation (PMR) Department of a tertiary care hospital in Kerala.

Methods

This study was carried out in the Department of PMR, Government TD Medical College, Alappuzha, during a period of one year from January 2016- December 2016 to

evaluate the demographic factors and medical conditions associated with CTS. This was a descriptive study conducted by evaluating the records of clinically and electrophysiologically confirmed cases of CTS in the electrophysiology lab which is functioning in the department.

Results

96 cases were included, 81 (84%) were females. 94 (98%) were right handed persons. 82 (86%) persons had bilateral symptoms with more involvement on the dominant hand. Age of patients ranged between 24 to 72 years (mean age 45.5 years). 88.5% belongs to 30-60 years age group and 40.6% of them were in the 41 to 50 year age group. CTS was more prevalent in females (Female-Male ratio: 5.4:1). The commonest demographic factors associated with CTS were square wrist (83.3 %) and obesity (44.8 %). The medical conditions associated were metabolic syndrome (25 %) and hypothyroidism (14.6 %). Few cases of CTS due to rheumatoid arthritis, post colle's fracture and a single case of pregnancy associated CTS was also observed. 6 of them were smokers and all were males. 78 (96%) of females were home makers. 11 were manual labourers (9 males and 2 females). 4 were computer professionals.

Conclusions

CTS was more common in females ($P < 0.001$) and in younger age group. Occurrence of square wrist was the commonest associated demographic factor (83.3%) and significantly associated with CTS in females (P value of 0.000) followed by obesity in 44.8%. Among the medical conditions; metabolic syndrome had the commonest association (25%), followed by type 2 diabetes (20.2%) and hypothyroidism (14.6%). There was a significant association with CTS and hypothyroidism among females (P value of 0.025).

Keywords: Carpal tunnel syndrome, square wrist, metabolic syndrome, diabetes, hypothyroidism, obesity.

1. Background

Carpal tunnel syndrome (CTS), or compressive neuropathy of the median nerve at the carpal tunnel is a cause of pain, numbness, and tingling in the upper extremities^{1,2} and an important cause of work disability^{3,4}. CTS is three to four times more common in females. CTS is the most common compressive neuropathy and it constitutes a major part of the occupational upper-extremity musculoskeletal disorders and is associated with considerable health care and indemnity costs.⁴ Although CTS has been described as the most common compressive neuropathy,² there are only few studies on the prevalence in the general population. A prospective population-based study by de Krom et al performed in the Netherlands attempted to determine the prevalence of CTS.⁵ In this study on 715 subjects (33% men) aged 25 to 74 years; the prevalence of electrophysiologically confirmed CTS was 5.8% in women and 0.6% in men.⁵ Higher prevalence rates for CTS have been found in certain occupational groups like computer professionals, jobs using vibrating tools etc^{6, 7, 8} and some studies showed positive family history¹¹ too.

There are several risk factors for the development of CTS. Medical risk factors include diabetes, hypothyroidism, metabolic syndrome, rheumatoid arthritis, prior wrist fracture and pregnancy^{9,12}. Square wrist and high BMI are the two main anthropometric abnormalities associated with CTS¹⁰.

In this study; we intended to evaluate the demographic factors and medical conditions associated with CTS. This was a hospital-based study carried out in the Outpatient Department of Physical Medicine and Rehabilitation of a tertiary care centre during a period of one year. This was a descriptive study conducted by evaluating the records of clinically and electro-physiologically confirmed cases of CTS in the electrophysiology lab which is functioning in the department.

CTS during pregnancy

Several studies confirmed the frequent occurrence of CTS in pregnancy^{9, 12}. C. Pazzaglia et al in a multicentric study¹² observed that most CTS cases improve spontaneously without treatment but only in half of women CTS symptoms disappeared one year after delivery.

Occupation and the carpal tunnel syndrome

Repetitive physical tasks, particularly executed with force or using vibrating hand tools, carry the chief risk of carpal tunnel syndrome for workers. Many studies have shown that CTS is three to four times more common in females and is thought to be in part to occupation^{6,7,8,11,13}. CTS has been shown to be common in occupation that have been filled predominantly by females like food processing, food manufacturing, construction works are closely associated with CTS^{14,15}. All these jobs involve forceful repetitive twisting and turning movements of wrists which may result in repetitive strain injuries to wrists in the long run.

Square wrist and CTS

Johnson et al in 1983 were the first to correlate wrist dimensions and median nerve latencies.¹⁶ He could demonstrate that a wrist ratio of 0.7 may be critical shape of wrists at which latencies tend to reach the upper limit of normal. Studies done by Gordon et al¹⁷, Edwards¹⁸, Nathan et al¹⁹ showed that estimation of T/W ratio of prospective employees during preplacement examination is highly significant. Edwards could demonstrate that out of the 100 employees who had got a wrist ratio of 0.75 and above; 99 developed CTS within 6 months. Nathan et al found that wrist ratio was third risk factor for CTS; age being first and BMI being second for slowing of sensory conduction of median nerve in longitudinal study of CTS in Industry.

Radecke²⁰ was also of the view that women had larger average wrist ratio than males. He also found that the patients with prolonged median DL had higher average wrist ratio than those of each gender without a median nerve sensory abnormality. Radecke²¹ could demonstrate that the relationship between average wrist ratio and the likelihood of median abnormality appeared to be not affected by occupation.

According to Khulman and Hennessy²²; the wrist squareness (T/W ratio ≥ 0.7) was the most objective sign in CTS because it was not based on subjective complaints and was also not consciously influenced by subjects. He also recommended that the T/W ratio should be made mandatory for employees during preplacement examinations. Prompt recognition of persons with the risk factor ie, T/W ratio ≥ 0.7 could provide timely treatment for the employee and this can save the time and energy of both employers and employees. Repetitive motion of wrists in the work place can result in the development of CTS in as short a time as 2 weeks; particularly in people with this risk factor for CTS²³.

Carpal tunnel syndrome in diabetes mellitus

CTS occurs frequently in patients with diabetes mellitus. The prevalence of CTS is higher in diabetic patients with peripheral polyneuropathy compared to patients with diabetes, who do not have diabetes-related late complications (30% vs. 14%)²⁴. Moreover, CTS seems to be a risk factor for later manifestation of diabetes mellitus, as patients with newly diagnosed diabetes showed CTS manifestation 1.4-fold more often than the age-matched reference population²⁴. A study by Perkins B. A. et al²⁵ had also shown that the prevalence of clinical CTS was 2% in the reference population, 14% in diabetic subjects without DPN, and 30% in those with DPN.

Carpal tunnel syndrome in hypothyroidism

Several retrospective studies reported the prevalence of neuropathy to be 10–70% in patients with hypothyroidism. The most common entrapment neuropathy is the carpal tunnel syndrome (CTS), which results of an increased pressure on the median nerve at the wrist, due to the accumulation of amynoglycane matter^{26,27}. One earlier study by Khedr EM et al reported that 52% of hypothyroid with peripheral nervous system involvement; entrapment neuropathy was the commonest (35%) and axonal neuropathy was recorded in 9% of these patients²⁷.

Carpal tunnel syndrome and metabolic syndrome

Metabolic syndrome appears to be a risk factor for CTS^{28,29}. At the same time, the presence of metabolic syndrome increases the severity of the disease^{28,29}.

Carpal tunnel syndrome in rheumatoid arthritis

Many studies found an increase in incidence of CTS in inflammatory arthropathies especially rheumatoid arthritis^{30,31}. A recent study by Kwang Hyun Lee et al³² had shown that the incidence rate of CTS in patients with RA was similar to the incidence rate of CTS in the general population. They also found that CTS occurrence did not

correlate with duration of RA and had no positive correlation with disease activity of RA.

Carpal tunnel syndrome after distal radius fractures

CTS is a known complication after distal radius fractures. A review of 565 patients by Cooney et al³³ revealed immediate or delayed CTS as the most common complication with distal radial fracture. The time of onset of CTS in these fractures can vary from a few hours to many years³⁴.

Carpal tunnel syndrome in females

CTS is more common in females. Many studies suggest that reason for this gender difference was due to:

- 1) The carpal tunnel cross sectional area relative to the size of the hand is constitutionally smaller in women than in men³⁵
- 2) The less compliance of carpal tunnel against indentation force among females than men³⁶.

2. Materials and Methods

The study entitled- “Demographic factors and medical conditions associated with CTS” is a hospital-based study carried out in the Outpatient Department of Physical Medicine and Rehabilitation, Government TD Medical College, Alappuzha, during a period of one year from January 2016- December 2016 to evaluate the demographic factors and medical conditions associated with CTS. This was a descriptive study on secondary data of hospital records conducted by evaluating the records of clinically and electrophysiologically confirmed cases of CTS in the electrophysiology lab which is functioning in the department.

Wrist thickness (T) and wrist width (W) are taken at the level of distal crease to calculate T/W ratio (Johnson’s index)²³. Wrists having T/W ratio ≥ 0.7 were classified as circular wrists /square wrists and those with <0.7 are called as rectangular wrists.

Obesity was defined by a BMI ≥ 25 . A BMI between 18.5- 22.9 was taken as normal. [In accordance with Health Ministry of India’s diagnostic cut-offs for BMI 2008.]³⁷

Metabolic syndrome was defined according to the consensus definition for adult Asian Indians. NCEP, ATP III recommends that three out of five clinical and/or biochemical abnormalities should be present to satisfy this labeling.^{37,38}

1. Abdominal obesity [waist circumference in cm]: males ≥ 90 , females ≥ 80
2. Dysglycemia [fasting blood glucose]: ≥ 100 mg%
3. Hypertension: BP $> 130/85$ [SBP > 135 and / DBP > 85 mm of Hg]
4. High triglycerides : ≥ 150 [mg/dl]
5. Low HDL: males < 40 , females < 50 [mg/dl]

Thyroid dysfunction was defined by the presence of abnormality in T3 , T4 or TSH levels.

Normal range: T3 = 0.7 – 2 ng/ml

T4 = 55 - 135 ng/ml

TSH = 0.18 – 4 micro IU/ml

Statistical Analysis

A total of 96 patients with clinically and electro physiologically (NCS) confirmed carpal tunnel syndrome who were evaluated in the electrophysiology lab during the study period were included in the study. All the data were entered in Microsoft excel sheet, rechecked and analysed with SPSS16 statistical software.

3. Results

96 patients with clinically and electro physiologically (NCS) confirmed carpal tunnel syndrome were included. Among them; 81 (84%) were females. CTS was more prevalent in females (Female-Male ratio: 5.4:1).

78 (96%) of females were home makers. 11 were manual labourers (9 males and 2 females). 4 were computer professionals.

94 (98%) were right handed persons. 82 (86%) persons had bilateral symptoms with more involvement on the dominant hand.

Age of patients ranged between 24 to 72 years (mean age 45.5 years). 88.5% belongs to 30-60 years age group and 40.6% of them were in the 41 to 50 year age group.

The commonest demographic factors associated with CTS were square wrist (83.3 %) and obesity (44.8 %). There occurred a statistically significant association between square wrist and CTS in females (P value of 0.000).

The main medical conditions associated with CTS were metabolic syndrome (25 %) and hypothyroidism (14.6 %). Few cases of CTS due to rheumatoid arthritis, post colle's fracture and a single case of pregnancy associated CTS were also observed. 6 were smokers and all among them were males.

4. Discussion

Carpal tunnel syndrome is the most common type of compressive neuropathy and is associated with many medical conditions and demographic factors. CTS can also present as symptom of some medical conditions like hypothyroidism. It is one of the most common neurological conditions seeking treatment from Physical Medicine and Rehabilitation department. It is also a main reason of referral to this department for electro-diagnostic evaluation. There are many associated conditions in the development of CTS and it may be a presenting symptom of some medical conditions like hypothyroidism. But unfortunately there have been only few studies done in past reporting these associations from India. . No similar studies were conducted in PM&R departments in India. The aim of this study is to evaluate the demographic factors and medical conditions associated with clinically

and electrophysiologically confirmed cases of CTS in patients evaluated in the electrophysiology lab of PM&R Department of a tertiary care hospital in Kerala.

In this study; the incidence of CTS in females is much more than the western literature (Female-Male ratio: 5.4:1) and 96% of females were home makers. This may be related to the more manual jobs that our females used to engage, which demands more forceful repetitive movements of wrists than their western counterparts where they depend more on machines for performing household jobs.

88.5% belonged to the 30-60 years age group; this is in full agreement with the literature³⁹. CTS are predominantly a disease of 30s or 40s. This shows the importance of years of occupational exposure in revealing the symptoms. Hence CTS is considered as one among the group of repetitive strain injuries.

This study had shown that T/W ratio is relevant in the evaluation of female patients with CTS. 95% of females with CTS had got square wrists and was seen only in 20% of the males in the study. This finding is in accordance with the literature^{35,36}. So, in our study also 'square wrist' appears to be an independent risk factor for the development of CTS among females. In these patients; participation in jobs involving repetitive use of wrist/usage of vibrating tools will precipitate the symptoms of CTS. Hence measurement of T/W ratio should be made mandatory for employees during pre-placement examination for jobs involving repetitive use of wrists.

The relevant associations of some medical conditions like metabolic syndrome, diabetes and hypothyroidism etc with carpal tunnel syndrome mandates detailed clinical and laboratory evaluation in persons with CTS.

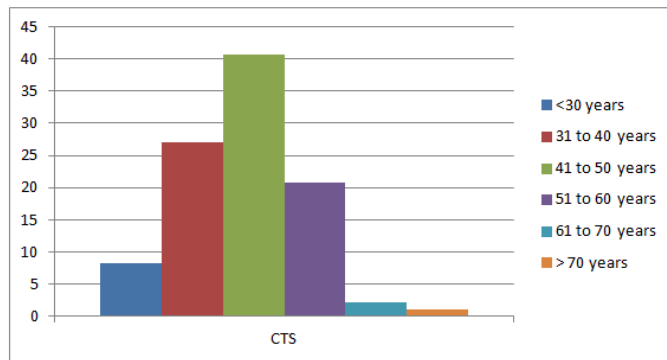
5. Charts and Tables

Table 1: Association of CTS with age

Age group	CTS n (%)
<30 years	8 (8.3 %)
31 -40 years	26 (27.1 %)
41 -50 years	39 (40.6 %)
51 -60 years	20 (20.8%)
61 -70 years	2 (2.1%)
>71 years	1 (1.0%)

CTS: Carpal tunnel syndrome

Figure 1: Association of CTS with age



CTS: Carpal tunnel syndrome

Diagnosis	Total	Females	Males	P value
CTS	96	81 (84.4% %)	15 (15.6 %)	0.00

Figure 2: Association of CTS with gender

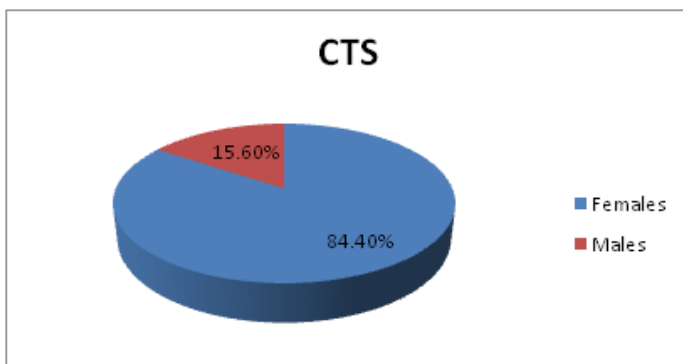
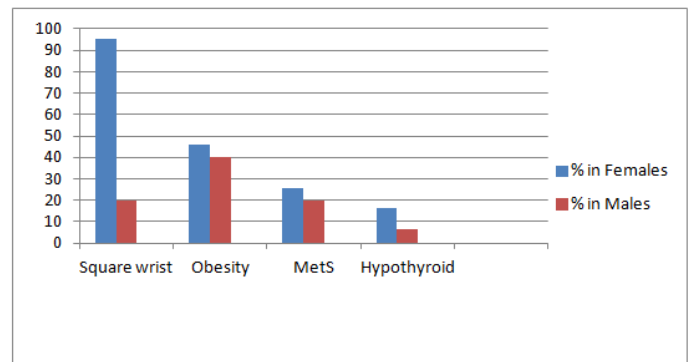


Table 3: Demographic and medical conditions associated with CTS

Conditions associated	Total (n= 96)	Females (n= 81)	Males (n=15)	P value
Square wrist	80 (83.3 %)	77 (95.1 %)	3 (20 %)	0.00
Obesity	43 (44.8 %)	37 (45.7%)	6 (40 %)	0.237
MetS	24 (25 %)	21 (25.9 %)	3 (20 %)	0.165
T2DM	21 (20.2 %)	18 (22.2 %)	3 (20 %)	0.329
Hypothyroidism	14 (14.6%)	13 (16.1 %)	1 (6.6 %)	0.025
Post Colle's fracture	2 (2 %)	2 (2.5 %)	0 (0.0%)	-----
RA	2 (1 %)	2 (2.5 %)	0 (0.0%)	-----
Pregnancy	1 (1 %)	1 (1.23 %)	0 (0.0%)	-----

MetS: metabolic syndrome, T2DM: Type 2 Diabetes mellitus, RA: Rheumatoid arthritis

Figure 3: Demographic and medical conditions associated with CTS



6. Conclusions

1. Females were more prone to the development of CTS. This had been shown by a higher female to male ratio.
2. CTS is predominantly a disease of middle age. 88.5% belonged to the 30-60 years age group.
3. Circular/ square wrist appears to be the commonest associated demographic factor in persons with CTS (83.3%). Square wrist was significantly associated with CTS in females.
4. A significant association of obesity was noticed among patients with CTS. 44.8% had associated obesity.
5. Metabolic syndrome (25%), diabetes (20.2%) and hypothyroidism (14.6%) were the main medical conditions associated with CTS.
6. The association of CTS with hypothyroidism was significant among females.

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