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ORIGINAL ARTICLES

Identification of Common Risk Factors Associated with Carpal Tunnel Syndrome

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Abstract

Objective: *To identify the common risk factors associated with carpal tunnel syndrome.* ***Methodology:*** *This case-control observational study was conducted in the department of neurology and medicine, DMCH from May 2010 to April 2011 for a duration of 1 year. The study included purposively selected 80 persons. Patients attending the outdoor and admitted in indoor of department of neurology and medicine, DMCH with a clinically suspected CTS and established by electrophysiological parameters selected as cases (group –I) . Healthy volunteers and subjects who were devoid of any features of CTS but having history with isolated injury to the lower limb nerve and isolated facial nerve palsy with normal electrophysiological parameters selected as control (group –II). Data were collected by interview of the patients, clinical examination and laboratory investigations using the research instrument.* ***Result:*** *The mean age was 42.7±9.8 years with range from 24 to 64 years and 41.1±9.1 years with range from 26 to 61 years in group-I and group-II respectively. The proportion of male and female patients was similar in both the study groups. Male Female ratio was 1: 7 in both groups. In this study it was observed that hypothyroidism was found 25.0% in group I and 5.0% in group II, which was significantly ($p<0.05$) higher in carpal tunnel syndrome patients. Diabetes mellitus was significantly higher in carpal tunnel syndrome patients, which was 22.5% in group I and 7.5% in group II. Rheumatoid arthritis was found 20.0% in group I and 5.0% in group II, which was significantly ($p<0.05$) higher in patients with carpal tunnel syndrome. Pregnancy was found 11.4% in group I and 2.9% in group II. CKD with hemodialysis was found 17.5% and 7.5% in group I and group II respectively. In pregnancy and CKD with hemodialysis difference was not statistically significant ($p>0.05$) among the two groups. Regarding obesity it was found in this present series that 42.5% and 17.5% patients were obese in group I and group II respectively. Obesity was significantly ($p<0.05$) higher in patients with carpal tunnel syndrome. In this study it was found in multivariate analysis that patients with hypothyroidism 1.28 times, DM 2.20 times, RA disease 3.84 times, obesity 5.9 times more likely to be associated with carpal tunnel syndrome but CKD with hemodialysis patients and pregnancy were not significantly associated in multivariate analysis. In this study it was also found that almost a half (47.5%) of the patients was housewives followed by garment workers (27.5%) and clerical workers (22.5%) in group I, which indicates that carpal tunnel syndrome was more common among housewives.* ***Conclusion:*** *A conclusion can be*

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made from the above mentioned result that CTS is multifactorial. Obesity, diabetes mellitus, hypothyroidism and rheumatoid arthritis are commonly associated with carpal tunnel syndrome. Moreover female sex and age were also associated with CTS. This study also found that patients diagnosed as having work-related CTS have a high prevalence of concurrent medical conditions capable of causing CTS without respect to any particular occupation.

Key Words: *Carpal tunnel syndrome, risk factors.*

Introduction:

Carpal tunnel syndrome (CTS) may be defined as the compression of the median nerve at the wrist (carpal tunnel) in the absence of an obvious injury, trauma or surgery. This is the commonest entrapment neuropathy[1-3]. The symptoms disturb sleep and affect performance at work. Many patients have to change their jobs or modify activities to decrease their symptoms[4,5].Women are three times more likely to develop CTS than men. The prevalence of CTS in general population has been estimated to be at 3-5.8% for women and 0.6-2.1% for men[6,7].

The associated conditions and disease for CTS are female sex, obesity, pregnancy and acromegaly, hypothyroidism, hemodialysis. rheumatoid arthritis and repeated use of vibrating hand tools, persons with diabetes or other metabolic disorders are also at high risk[8-13]. CTS usually affects only adult[1,14] .CTS have a relationship with diabetes mellitus, hypothyroidism and rheumatoid arthritis. For all three conditions, there are arguments that they are not simply concurrent with CTS but interact with the CTS development itself. Diabetes mellitus predisposes to development of peripheral neuropathy, which can make the median nerve more sensitive to alterations of the carpal tunnel and thus predisposes to CTS development. Hypothyroidism produces alterations of fluid balance and peripheral tissue oedema, which may lead to CTS development. The inflammatory process of rheumatoid arthritis can increase the pressure in the carpal tunnel, which may also lead to CTS[15].

Carpal tunnel syndrome cases have a significant correlation with higher BMI when compared to control subjects[16].BMI as an independent risk factor for CTS in both genders. Wrist index and hand anthropometrics were found to be independent risk factors for CTS in females but not in males[17]. Increase weight and more recently, body mass index as risk factor for CTS. Those individuals who were classified as obese (BMI>29) were 2.5 times more likely than slender individuals (BMI<20) to be diagnosed with CTS[18].So common risk factors are obesity, diabetes mellitus, hypothyroidism, rheumatoid arthritis and occupation[19-21].

Some cases of CTS are occupationally induced. The work related wrist and hand syndrome (repetitive motion injury) from cumulative trauma in the workplace have received increasing attention by the general public in recent years. Although a proportion of these cases have genuine CTS, longitudinal natural history data suggest that the majority of industrial workers do not develop symptoms of CTS[22]. Increased risk for the syndrome has been found in meat packers, garment workers, butchers, grocery checkers, electronic assembly workers, keyboard operators, musicians and housekeepers. The highest reported incidence of work-related CTS based on the number of carpal tunnel surgeries performed was 15% among a group of meat packers[23].

Neurophysiological investigation in the form of nerve conduction study (NCS) is a well established tool for the diagnosis and grading of CTS. The results of electro diagnostic studies have been found to be highly sensitive and specific[24-27]. Like other countries of the world, CTS is also assumed to be present in Bangladeshi population as all the precipitating factors are prevailing and in fact gradually increasing with the passage of time as females are increasingly being involved in various industrial works. On the other hand electrophysiological procedures including NCS have become quite available and popular in various centers of Bangladesh as a valuable investigation tool to diagnose entrapment neuropathies, like carpal tunnel syndrome. Like every where else,

neurophysiological investigation in the form of NCS is able to diagnose more than 84% of the clinically suspected CTS cases in Bangladeshi population[28]. It has been observed that there is no study regarding the risk factors associated with CTS in Bangladeshi population. Therefore a case-control syudy was done to identify the common risk factors associated with carpal tunnel syndrome.

Methodology

Study design:
Observational case controlled study.

Place and period of Study:
This study was carried out in the Department of Neurology and Medicine inpatient and outpatient department of Dhaka Medical College and Hospital (DMCH), Dhaka from May 2010 to April 2011 for duration of one year.

Study population:
Patients with a clinically suspected CTS and established by electrophysiological parameters.

Sampling procedure:
The required number of cases and controls were selected consecutively.

Inclusion criteria:

For cases (Group-I):

1) Clinical:
   a) Patients had typical clinical features of carpal tunnel syndrome. (Appendix-8.II)
   b) Patients who were willing to enter the study,
2) Electrophysiological (One or any combination of the following) :- (Preston and Shapiro 1998).
   a) Median sensory distal latency more than 3.51 ms.
   b) Median motor distal latency more than 4.35 ms
   c) Median nerve CMAP less than 6.79 mv.
   d) Median nerve MNCV (motor nerve conduction velocity) less than 47.32 m/ sec.

For controls :(Group-II)

1) Clinical
   a) Healthy volunteers,
   b) Patients with isolated injury to the lower limb nerve or facial palsy
2) Electrophysiological- normal parameters (Preston and Shapiro .1998)
   a) Median sensory distal latency less than 3.51 ms
   b) Median motor distal latency less than 4.35 ms
   c) Median nerve CMAP more than 6.79 mv
   d) Median nerve MNCV more than 47.32 m/ sec

Exclusion criteria for cases:

- Symptoms less than 3 months,
- Conditions that mimics CTS such as cervical radiculopathy, proximal median neuropathy or significant polyneuropathy ,
- Cognitive impairment interfering with subjects ability to follow instructions and describe symptoms ,
- Patients who were above 70 years & below 18 years of age,
- Patients with carpal tunnel syndrome having history of hand trauma,
- Patient who refused to enter into the study.
- Patients with diabetes mellitus, nephrotic syndrome, myxoedema which might affect the blood lipid.
- Any other chronic clinical conditions which can alter lipid profile.
- Patients taking carbamazepine for less than two years.

Data processing and statistical analysis:
Analysis of data was done with the help of computer by SPSS programmed version of 16.0 software facilities. Appropriate statistical methods (unpaired t test, chi square test) were applied for data analysis and comparison. The significance of data was done

with 95% confidence interval taking p value d" 0.05 as significant.

Results:

The mean age was 42.7±9.8 years with range from 24 to 64 years and 41.1±9.1 years with range from 26 to 61 years in group-I and group-II respectively. The proportion of male and female patients was similar in both the study groups. Male Female ratio was 1: 7 in both groups.

The symptoms of the group-I subjects were tingling of the hands (60%) followed by pain (30%), numbness (25%), wasting (10%), and weakness (10%).The most of the control subjects were healthy volunteers (62.5%). Facial palsy constituted 12.5% and rest (25%) were isolated lower limb nerve injury. Regarding occupation almost a half (47.5%) of the patients was housewives followed by garment workers (27.5%) and clerical workers (22.5%) in group I. Regarding the affected hand it was found that right hand was more frequent, which was 55.0% and left hand was 10.0% in group I.

Hypothyroidism was found in 10(25.0%) cases in group I and 2(5.0%) in group II. The difference was statistically significant (p<0.05) between two groups regarding hypothyroidism.

Diabetes mellitus was found 9(22.5%) in group I and in 3(7.5%) cases in group II. The difference was not statistically significant (p>0.05) between two groups regarding diabetes mellitus.

Rheumatoid arthritis was found 8(20.0%) in group I and in 2(5.0%) cases in group II. The difference was statistically significant (p<0.05) between two groups regarding rheumatoid arthritis.

Pregnancy was found in 4(11.4%) cases in group I and in 1(2.9%) case in Group II. The difference was not statistically significant (p>0.05) between two groups regarding pregnancy.

Obesity was found in 17(42.5%) cases in group I and in 7(17.5%) cases in group II. The difference was statistically significant (p<0.05) between two groups regarding obesity.

CKD with hemodialysis was found in 7(17.5%) cases in group I and in 3(7.5%) cases in group II. The difference was not statistically significant (p>0.05) between two groups regarding CKD with hemodialysis.

In this study it was found in multivariate analysis that patients with hypothyroidism 1.28 times, DM 2.20 times, RA 3.84 times, obesity 5.9 times more likely to be associated with carpal tunnel syndrome but CKD with hemodialysis patients and pregnancy were not significantly associated in multivariate analysis.

Table 1-A

Number of Hypothyroidism in group-I and group-II

	Group I (n=40)		Group II (n=40)		95% CI	P value
Hypothyroidism	No.	%	No.	%		
present	10	25.0	2	5.0	6.33(1.16-45.51)	0.012[s]
absent	30	75.0	38	95.0		

Table 1-B

Number of diabetic mellitus in group-I and group -II

	Group I (n=40)		Group II (n=40)		95% CI	P value
Diabetes mellitus	No.	%	No.	%		
present	9	22.5	3	7.5	3.58(0.79-18.46)	0.060[ns]
absent	31	77.5	37	92.5		

Table 1-C

Number of rheumatoid arthritis in group-I and group-II

	Group I(n=40)		Group II(n=40)		95% CI	P value
Rheumatoid arthritis	No.	%	No.	%		
present	8	20.0	2	5.0	4.75(0.84-35.08)	0.042[s]
absent	32	80.0	38	95.0		

Table 1-D

Number of pregnancy in group-I and group-II.

	Group I(n=35)		Group II(n=35)		95% CI	P value
Pregnancy	No.	%	No.	%		
present	4	11.4	1	2.9	4.39(0.42-108.9)	0.176[ns]
absent	31	88.6	34	97.1		

Table 1-E

Number of obesity in group-I and group-II.

	Group I(n=40)		Group II(n=40)		95% CI	P value
Obesity	No.	%	No.	%		
present	17	42.5	7	17.5	3.48(1.12-11.13)	0.014[s]
absent	23	57.5	33	82.5		

Table 1-F

Number of CKD with hemodialysis in group-I and group-II.

	Group I(n=40)		Group II(n=40)		95% CI	P value
CKD with hemodialysis	No.	%	No.	%		
present	7	17.5	3	7.5	2.62(0.54-14.07)	0.176[ns]
absent	33	82.5	37	92.5		

Table 2

Multivariate predictors of carpal tunnel syndrome with common risk factors (n=80)

	Crude	95% CI		P value	Adjusted	95% CI		P value
	OR	Lower	Upper		OR	Lower	Upper	
Hypothyroidism	6.33	1.16	45.51	0.012[s]	1.28	0.91	11.81	0.047[s]
DM	3.58	0.79	18.46	0.060[ns]	2.20	1.28	21.06	0.021[s]
RA	4.75	0.84	35.08	0.042[s]	3.84	1.29	47.61	0.025[s]
Obesity	3.48	1.12	11.13	0.014[s]	5.90	1.54	22.61	0.010[s]
CKD withhemodialysis	2.62	0.54	14.07	0.176[ns]	1.12	0.23	5.44	0.880[ns]
Pregnancy	4.39	0.42	108.9	0.176[ns]	3.28	0.91	11.8	0.070[ns]

Discussion:

This case controlled study was carried out with an aim to identify the common risk factors i.e. obesity, diabetes mellitus, hypothyroidism, rheumatoid arthritis associated with carpal tunnel syndrome in comparison with healthy persons. A total of 40 patients having symptoms of CTS and established by etectrophysiological parameters selected as cases and 40 subjects who were devoid of any feature of CTS and had normal etectrophysiological parameters with matching the background characteristics selected as control. This study was carried out in the Department of Neurology and Medicine, Dhaka Medical College Hospital (DMCH) during May, 2010 to April, 2011.

In this current study it was found that the mean (±SD) age was 42.7±9.8 years with range from 24 to 64 years and 41.1 ±9.1 years with range from 26 to 61 years in group I and group II respectively. The age distribution between two groups was almost similar, no significant ($p>0.05$) difference was found between two groups. Maximum number was found in the 5th decade in both groups. Similarly, Ferry et al. (2000) found the mean age was 41.9 years for both cases and controls[29]. In another study, Steven, John and Wing (1998) showed the mean age of their patients was 40 years and 83% aged between 25 to 54 years[30]. Vessey, Mackintosh and Yeates (1990) reported that standardized first referral rates for carpal tunnel syndrome doubled as age increased from 25-29 to 50 or more[31]. Ferry et al. (2000) and Zambelis, Tsivgoulis and Karandreas (2010) mentioned that the syndrome was associated in older age group, which is higher with the present study, this may be due to geographical and racial influences may have significant impacts on CTS[32].

In this present study male and female were found 12.5% and 87.5% respectively in both groups and male female ratio was 1:7, which indicates that carpal tunnel syndrome is more common in female. Solomon *et al*. (1999) found female 74.0%, which is consistent with the present study[12]. In another study Steven, John and Wing (1998) showed that 70.0 percent patients were female[30]. Ferry *et al*. (2000), Dieck and Kelsey (1985) and Zambelis, Tsivgoulis and Karameros (2010) mentioned that syndrome was associated in older age group of women with some hormonal factors, notably past use of oral contraceptives[29,32,33].

In this present series it was found that almost a half (47.5%) of the patients was housewives followed by garment workers (27.5%) and clerical workers (22.5%) in group I, which indicates that carpal tunnel syndrome was more common in housewives. Mattioli *et al* (2009) found that house wives were 3.8 fold higher than standardized rate[34]. The high rates for full-time housewives suggest that domestic chores should be investigated as a possible risk factor for CTS. A large proportion of patients (27.5%) were garment workers, hence ergonomic factors are likely to contribute in the causation of CTS. Steven, John and Wing (1998) hypothesized that many patients already medically certified with a diagnosis of work-related CTS in fact have an underlying medical condition that could cause these symptoms irrespective of occupation[30]. Peter *et al* (1992) study suggests that characteristics, not job-related factors, are the primary determinants of slowing of sensory conduction of the median nerve and carpal tunnel syndrome[35]. Regarding the affected hand it was found in this current series that both hands were affected, which was 55.0%, followed by right hand 35.0% and left hand 10.0% in group I.

In this study it was observed that hypothyroidism was found in 25.0% cases in group I and 5.0% in group II, which was significantly ($p<0.05$) higher in carpal tunnel syndrome patients OR=6.33 [95% CI (1.16-45.51)]. Solomon *et al.* (1999) showed hypothyroidism had significant risk factors OR=1.7; (95% CI 1.1, 2.8)[12]. Similarly, Steven, John and Wing (1998) mentioned that two metabolic diseases hypothyroidism and diabetes mellitus were most prevalent in their study patients[30].

In this series it was found that diabetic mellitus was significantly higher in carpal tunnel syndrome patients, which was 22.5% in group I and 7.5% in group II. In a study, Zambelis, Tsivgoulis and Karandreas (2010) showed that diabetes mellitus was more prevalent in patients with bilateral CTS[32]. Mota et al. (2001) mentioned that carpal tunnel syndrome occurred approximately in 50.0% of the diabetic patients, affecting their activity and decreasing the quality of their life[36]. Similarly,

Steven, John and Wing (1998), Solomon *et al.* (1999) and Ferry *et al.* (2000) reported that diabetes mellitus was the most prevalent, which are consistent with the current study[3,12,29,30].

In this current study it was found that rheumatoid arthritis was found in 20.0% cases in group I and in 5.0% cases in group II, which was significantly ($p<0.05$) higher in patients with carpal tunnel syndrome. Similarly, Ferry *et al*. (2000) and Solomon *et al.* (1999) mentioned that the cause of most CTS is not known, but numbers of diseases that affect the local architecture of the wrist are associated with it, including rheumatoid arthritis and Colles fracture[12,29].

In this present study it was found that pregnancy was found in 11.4% cases in group I and in 2.9% cases in group II. CKD with hemodialysis was found in 17.5% cases and in 7.5% cases in group I and group II respectively. In pregnancy and CKD with hemodialysis difference were not statistically significant ($p>0.05$). Solomon *et al.* (1999) reported that the pregnancy was not significantly associated with CTS, which support the present study[12].

Regarding the obesity it was found in this present series that 42.5% and 17.5% patients were obese in group I and group II respectively. Obesity was significantly ($p<0.05$) higher in patients with carpal tunnel syndrome. Vessey, Mackintosh and Yeates (1990) showed an increase in BMI of 1.99 to 2.6 causes doubling of carpal tunnel syndrome[31]. In another study, Peter *et al.* (1992) reported that weight and BMI were strongly and positively correlated with the maximum latency difference (MLD)[35]. The risk for abnormal nerve conduction averaged 3.5-fold and 4.1-fold greater, respectively in the obese workers than in the slender workers. Similarly, Zambelis, Tsivgoulis and Karandreas(2010) and Steven, John and Wing (1998) found higher BMI was more prevalent in patients with bilateral CTS[30,31].

In this study it was found in multivariate analysis that patients with hypothyroidism 1.28 times, DM 2.20 times, RA 3.84 times, obesity 5.9 times more likely to be associated with carpal tunnel syndrome but CKD with hemodialysis patients and pregnancy were not significantly associated in multivariate analysis. Karpitskaya, Novak and Mackinnon (2002) mentioned that Carpal tunnel syndrome (CTS) had been frequently associated with physical factors and personal factors including smoking, obesity, diabetes mellitus, and hypothyroidism[37]. There were more CTS patients than control subjects who were obese ($p=0.02$; OR=1.77), had diabetes ($p=0.03$; OR=3.02), and hypothyroidism ($p=0.02$; OR=3.70), which is comparable with the present study. In another study, Stevens *et al.* (1992) showed rheumatoid arthritis and diabetes mellitus were significantly more frequent among the study patients with carpal tunnel syndrome than in the general population. The standardized morbidity ratio was 3.6 for rheumatoid arthritis and 2.3 for diabetes mellitus. Similarly, Steven, John and Wing (1998) mentioned that many medical conditions, including diabetes mellitus, thyroid disease, wrist osteoarthritis, and any form of inflammation affecting the wrist joints or tendon sheaths are associated with CTS[30]. Solomon *et al*. (1999) developed a multivariate model and found inflammatory arthritis was strongly associated with carpal tunnel release OR=2.9; (95% CI 2.2, 3.8)[12]. Several variables remained significant risk factors including female gender OR=1.6; (95% CI 1.3, 2.0), inflammatory arthritis OR=3.1; (95% CI 2.2, 4.2), diabetes OR=1.4; (95% CI 1.2, 1.8), hypothyroidism OR=1.7; (95% CI 1.1, 2.8), corticosteroid use OR=1.6; (95% CI 1.2, 2.1) and hemodialysis OR=9.0; 95% CI 4.2, 19.6). Both definitions of inflammatory arthritis were significantly associated with CTS surgery in unadjusted and multivariate analyses, and other variable point estimates were not changed. These results support current study that CTS is multi factorial, with such factors as hypothyroidism, diabetes, RA and obesity to be more prevalent in this group of CTS patients.

Conclusion:

A conclusion can be made from the above mentioned result that CTS is multi factorial. Obesity, diabetes mellitus, hypothyroidism and rheumatoid arthritis are commonly associated with carpal tunnel syndrome. Moreover female sex and age were also associated with CTS. This study also confirmed the hypothesis that patients diagnosed as having work-

related CTS have a high prevalence of concurrent medical conditions capable of causing CTS irrespective of any particular occupation

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