

A COMPARATIVE STUDY OF NERVE LATENCIES AND CONDUCTION VELOCITY IN PREGNANT AND NON-PREGNANT FEMALES FOR THE DIAGNOSIS OF PRCTS

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Abstract

Background: Carpal tunnel syndrome is the most common compression neuropathy of median nerve which may occur or aggravate during pregnancy. The location of median nerve in the carpal tunnel at the level of wrist joint makes the nerve prone to entrapment neuropathy due to any condition that might increase the fluid pressure. Pregnancy is one important cause which leads to altered fluid balance, therefore it's important to study the median nerve parameters by electrodiagnostic techniques in pregnant females and compare the former with healthy age matched non-pregnant females in order to diagnose pregnancy related carpal tunnel syndrome (PRCTS).

Aim: To compare nerve latencies and conduction velocity in pregnant and non-pregnant females for the diagnosis and incidence of PRCTS. **Materials and Methods:** This was a cross-sectional and descriptive study done in the dept. of physiology, JNMCH, AMU. 75 pregnant females (cases) and age matched 75 healthy non-pregnant females (controls) were randomly selected from the gynaecology OPD of the aforesaid hospital. Electrodiagnostic techniques were then used to evaluate the latency and conduction velocity of the sensory and motor aspect of the median and ulnar nerve of the cases and controls in order to diagnose pregnancy related carpal tunnel syndrome (PRCTS) in the cases. The values obtained of the pregnant females were then compared with the non-pregnant females. **Results:** There was a statistically significant difference found between the prolonged nerve latency of median nerve (sensory as well as motor) in pregnant females (cases) and non-pregnant females (controls). Incidence of PRCTS among the cases diagnosed by the electrodiagnostic criteria was found to be 48%. **Conclusions:** A higher incidence PRCTS was observed in the pregnant females. Majority of the asymptomatic cases were diagnosed by the electrodiagnostic criteria. Therefore it can be stated that electrodiagnostic studies should be conducted in the pregnant women as a part of their regular ANC.

INTRODUCTION

Carpal tunnel syndrome (CTS) is a well-known median nerve neuropathy.^[1,2] It comprises of 90% of all neuropathies.^[3] A higher prevalence rate is noted in females (9.2%) than in males (6%). Younger age groups are usually more at risk.^[1,4]

The compression and traction of the median nerve inside the carpal tunnel causes this neuropathy.^[5] Clinical presentation is tingling and numbness in the typical median nerve distribution in the radial three and a half digits (thumb, index, long and radial side of the ring). A deep aching or throbbing pain may be present sometimes, occurring diffusely in the hand and radiating up the forearm. Thenar muscles

atrophy is a rare presentation, may be seen in extreme cases.^[7]

Carpal Tunnel Syndrome in Pregnancy

Maternal circulatory system changes during pregnancy play a direct role in the causation of CTS. The maternal blood volume increases about 30% above normal during the later half of pregnancy. The contributing factors are the hormones, aldosterone and estrogen which are greatly increased in pregnancy. At the time of birth of the baby, the mother has about 1-2 L of extra blood in her circulatory system.^[8]

There are various causes of altered fluid balance in the human body namely pregnancy, menopause, eclampsia, thyroid disorders (hypothyroidism), renal failure, long term hemolysis, Raynaud's disease and

obesity. Pregnancy is the most significant physiological cause for altered fluid balance.^[9] Since almost all the females go through childbearing more than once in their life, a study on PRCTS can be of great value.^[10] Higher incidence of CTS in pregnancy and lactation is seen. During pregnancy progression and future pregnancies an increase in the severity of CTS is seen. Early detection and treatment with noninvasive methods is of utmost importance as invasive methods are avoided during pregnancy.^[11]

The most frequent mononeuropathy during pregnancy is pregnancy related Carpal tunnel syndrome (PRCTS). A wide variation is reported in the incidence of PRCTS which ranges from 0.8 to 70%. Diagnostic technique determines the incidence. The etiology for PRCTS comprises of hormonal fluctuations and fluid accumulation during pregnancy.^[12] Tendency to oedema and nerve hypersensitivity are factors that predispose pregnant women to the development of symptoms.^[13] The diagnosis of PRCTS includes a thorough history, typical symptoms, physical examinations and necessary investigations.^[12]

A higher incidence of persistent, painful diurnal symptoms have been reported in PRCTS than in idiopathic CTS. PRCTS can occur in primigravida as well as multigravida. With advancing number of pregnancies the incidence and severity of PRCTS increases.^[14]

MATERIALS AND METHODS

This cross-sectional study was conducted in the department of physiology in collaboration with department of Obstetrics and Gynaecology, JNMCH, AMU, Aligarh, from October 2018 to September 2020.

Sample: sample size was determined using the formulae described below.

$$\text{Sample size} = \frac{Z^2 \times P \times (1 - P)}{d^2}$$

Where,

Z = 1.96

P = prevalence of PRCTS

d = Absolute error or precision

Taking prevalence of PRCTS in Asian population as 26% [61] and 10% absolute error, sample size comes out to be 72.

Statistical Analysis

All the data was compiled on Microsoft office excel 2013. Analysis was performed using SPSS version

20.0 statistical package for windows (SPSS, Chicago, IL).

As per eligibility criteria, a total of 100 subjects were taken after taking a written, valid and informed consent. Out of these 100 subjects, 75 were pregnant females of first, second and third trimester, 25 in each trimester; 75 subjects were age-matched non-pregnant females for control purpose. A detailed history and complete physical examination of every subject was done and recorded as per a pre designed proforma. Then, nerve conduction study of each subject was performed and results were recorded.

Eligibility Criteria

Pregnant females without symptoms of CTS before pregnancy, asymptomatic pregnant females with an electrodiagnostic finding which satisfies the criteria of CTS diagnosis, pregnant females who have signs and symptoms of CTS starting after the beginning of pregnancy were included. Pregnant women with a history of trauma or fracture of hand (Colle's fracture), hypothyroidism, diabetes, or any previously diagnosed neuropathy, pre-existing autoimmune diseases, obesity and smoking were excluded.

Procedures

Electrodiagnostic studies

Electrodiagnostic studies includes Nerve Conduction velocity, Latency and amplitude of the sensory and motor component of median and ulnar nerve (15). It's a gold standard and confirmatory test for the diagnosis of CTS (16). A distal motor latency of >4.5ms and a sensory latency of >3.5ms are considered abnormal.(17)

Electrodiagnostic Evaluation of the Study Population

The electrodiagnostic test was performed on both the hands of study population. The nerves tested were median nerve and ulnar nerve. The sensory and motor aspect of both the nerves of both the hands was tested. A record of latency and conduction velocity of nerves was made and evaluated.

1 Unpaired t-test was applied for the comparison of the nerve latencies in between the pregnant females (cases) and non-pregnant females (controls).

The following Table No- 01 shows the average latencies of median and ulnar nerves of both the hand. The average right and left median motor latency in pregnant females is equal to 4.18 ms and 4.004 ms respectively. There is a statistically significant difference when these values are compared with the corresponding values in non-pregnant females. This rise in the value of median motor nerve latency in case of pregnant females predisposes them to the risk of developing PRCTS.

Table 1: Comparison between the nerve latency of pregnant females (cases) and non-pregnant females (controls)

Nerve Latency	Pregnancy Status	Sample Size	Mean	Standard Deviation	Standard Error of Mean	Significance
Right Median Motor Latency	Pregnant	75	4.1811	1.59573	0.18426	0.000
	Non-pregnant	75	2.9788	0.43512	0.08702	

Left Median Motor Latency	Pregnant	75	4.0004	1.41500	0.16339	0.000
	Non-pregnant	75	3.0928	0.52113	0.10250	
Right Ulnar Motor Latency	Pregnant	75	2.6281	0.71035	0.08202	0.457
	Non-pregnant	75	2.3828	0.51248	0.10423	
Left Ulnar Motor Latency	Pregnant	75	2.5009	0.60038	0.06933	0.347
	Non-pregnant	75	2.3236	0.41498	0.08300	
Right Median Sensory Latency	Pregnant	75	3.4857	1.06839	0.12337	0.001
	Non-pregnant	75	2.6748	0.38243	0.07649	
Left Median Sensory Latency	Pregnant	75	3.3384	0.85790	0.09906	0.000
	Non-pregnant	75	2.8460	0.30683	0.06137	
Right Ulnar Sensory Latency	Pregnant	75	2.5765	0.66550	0.07685	0.426
	Non-pregnant	75	2.6224	0.40911	0.08182	
Left Ulnar Sensory Latency	Pregnant	75	2.4991	0.80579	0.09304	0.261
	Non-pregnant	75	2.4568	0.35746	0.07149	

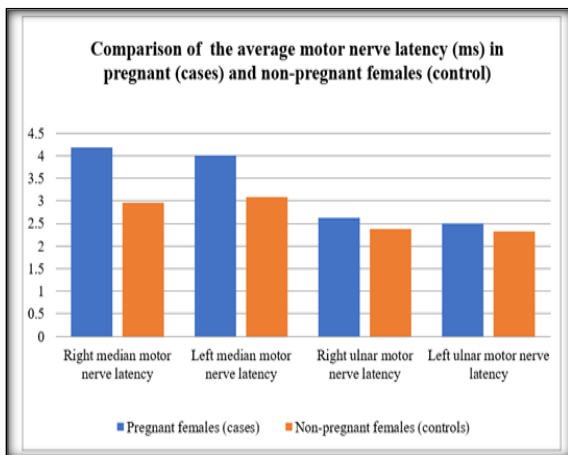


Figure 1: Comparison of the average motor nerve latency (ms) in pregnant (cases) and non-pregnant females (controls)

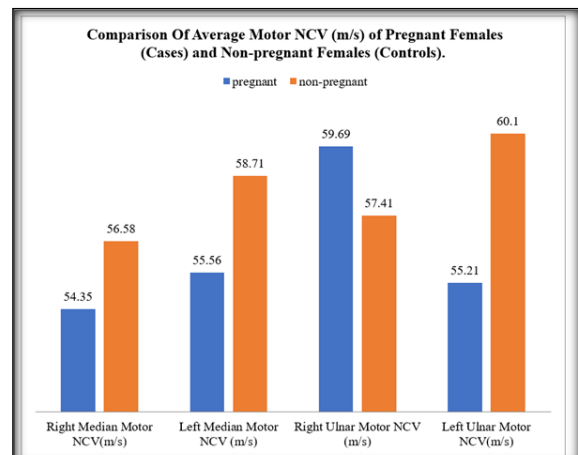


Figure 3: Shows the average motor NCV (m/s) of median and ulnar nerves in case of pregnant females (cases) compared to that of non-pregnant females (controls)

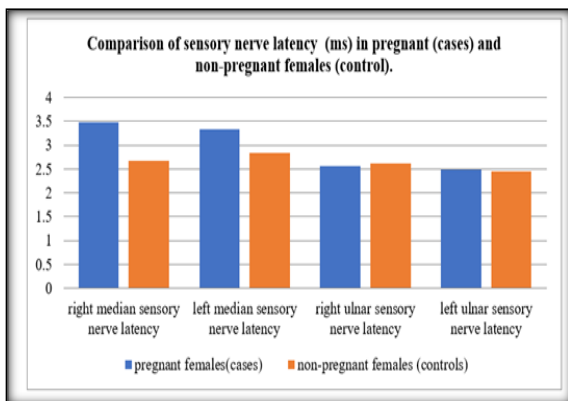


Figure 2: Comparison of sensory nerve latency (ms) in pregnant (cases) and non-pregnant females (controls)

The significance value 0.000 depicts highly significant difference in between the the nerve latency of pregnant females (cases) and non-pregnant females (controls)

- Right median motor latency (significance =0.000)
- Left median motor latency(significance=0.000)
- Right sensory median latency (significance=0.001)
- Left median sensory latency(significance=0.000)

The average motor NCV of the pregnant females (cases) is less than that of the non-pregnant females (controls) in all the motor nerves. There is significant association between the motor NCV and pregnancy (significance=0.000, $p < 0.05$ in all the motor NCV).

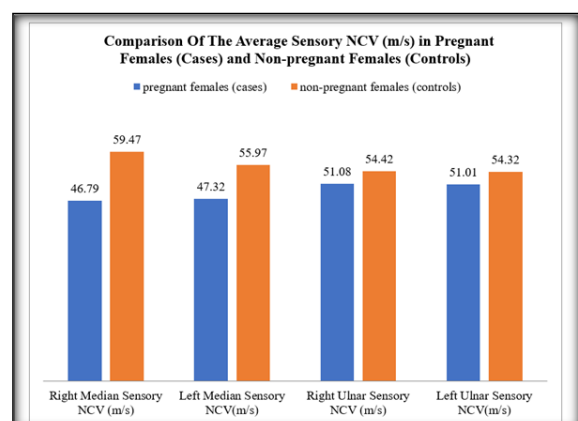


Figure 3: Shows comparison of the average sensory NCV (m/s) in pregnant females (cases) and non-pregnant females (controls)

The average sensory NCV of the pregnant females (cases) is less than that of the non-pregnant females (controls) in all the sensory nerves. There is significant association between the right and left median sensory NCV and pregnancy (significance=0.000, $p<0.05$). There is no significant association between the right and left ulnar sensory NCV with pregnancy ($p\text{-value}>0.05$).

2 Diagnosis of PRCTS in the Study Population by Electrodiagnostic Technique

Incidence of PRCTS among the pregnant females diagnosed by the electro diagnostic criteria.^[6]

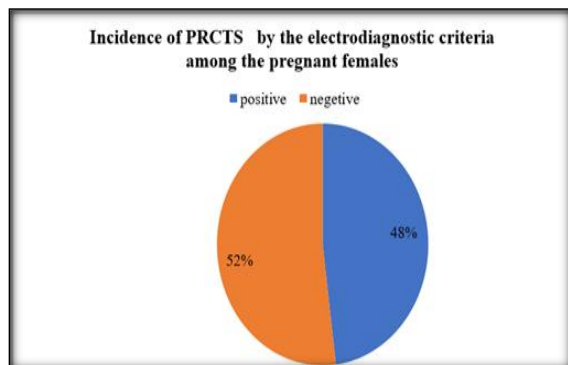


Figure 4: Shows us the total number of pregnant females diagnosed as PRCTS positive. Out of the 75 pregnant females studied 36 were diagnosed as a case of PRCTS. Incidence of PRCTS was found as 48% by the electrodiagnostic technique (EDX)

RESULTS

This study evaluated the electrodiagnostic values of median and ulnar nerve of age matched pregnant and non-pregnant females, in order to assess the prevalence of PRCTS.

The following conclusions are drawn from the study

1. There was a statistically significant difference found between the prolonged nerve latency of median nerve (sensory as well as motor) in pregnant females (cases) and non-pregnant females (controls).
2. There was a statistically significant reduction found between the motor conduction velocity of both the ulnar and median nerve in pregnant females when compared with the non-pregnant females.
3. There was a statistically significant reduction found in the sensory conduction velocity of median nerve in pregnant females when compared with the non-pregnant females.
4. The difference between the sensory ulnar conduction velocity between the pregnant and non-pregnant females was found not found to be significant.
5. Incidence of PRCTS among the cases diagnosed by the electrodiagnostic criteria in our study was found to be 48%.

DISCUSSION

PRCTS among the pregnant females was diagnosed by the nerve conduction study on electrodiagnostic criteria.^[6] The incidence of PRCTS among the 75 pregnant females in our study was found to be 48%. Similar findings are also observed in the following studies: Mondelli M et al (2007) did a prospective study of CTS in pregnant women in which they found that the incidence of PRCTS is ranging from 1 to 60%.^[22] Susan Ferry et al (2000) did a nested case-control study of CTS in women which indicated that pregnancy has a very strong association with CTS. They concluded that occurrence of CTS is very commonly seen in pregnancy.^[23]

C Pazzaglia et al (2003) did a multicenter study on the incidence of PRCTS and its natural course. The study results showed that CTS occurs frequently in pregnancy.^[24] Emir Tupkovic et al (2007) studied median nerve's neurophysiological parameters in pregnancy. They stated that there was a very high incidence (75%) of CTS in pregnant women diagnosed with neurophysiologically.^[25] Robert H Ablove et al (2009) studied the prevalence of CTS in pregnant women which indicated that Carpal tunnel syndrome (CTS) is a frequent complication of pregnancy, with a prevalence reported as high as 62%.^[26] Saeid Khosrawi et al (2012) did a study which concluded that the prevalence of CTS is relatively high in pregnant women.^[18] Meems M et al (2015) did a prospective study on prevalence, course and determinants of carpal tunnel syndrome symptoms during pregnancy. The study concluded a very high prevalence of CTS in pregnancy.^[27]

The average right and left median motor latency in pregnant females was found to be 4.18 ms and 4.004 ms respectively. There was a statistically significant difference found when these values were compared with the corresponding values in non-pregnant females. ($P\text{-value}<0.05$). There was a statistically significant difference found in case of the right median motor latency (significance =0.000), left median motor latency (significance=0.000), right sensory median latency (significance=0.001) and left median sensory latency (significance=0.000). Ulnar nerve latency (sensory and motor) of pregnant and non-pregnant females was also compared and no statistically significant difference was found between them. ($P\text{-value}>0.05$). Similar observations were found in a previous study done by Sapana S. Motewar et al (2017) in which the latency of left median nerve was significantly prolonged while the ulnar nerve conduction remained unaffected in pregnant women.^[28] Thus it can be stated that the median nerve latencies are significantly affected and prolonged in pregnancy when compared to the ulnar nerve latencies which remain unaffected by the state of pregnancy.

These observations are in line with the findings of Louis H. Weimer et al (2002) who conducted a

study on pregnant females to assess the functioning of median nerve and found that there was a significant prolongation of distal motor latency of median nerve which was eventually diagnostic for PRCTS.^[19] Similar observations were noted in a study done by Baumann F et al (2007) where a significantly increased latency of median nerve was found in pregnant females (p-value<.05) whereas ulnar nerve latency showed no significant change (p-value>.05).^[20] In another study, Eogan M. et al (2004) reported a statistically significant increase in the latency of median nerve in pregnant females (p-value<.05). The same study reported a very high intra palmer (median nerve latency- ulnar nerve latency) latency difference (0.6ms) in the symptomatic pregnant females which was highly diagnostic of CTS in pregnancy.^[29]

CONCLUSION

Thus it can be concluded that the median nerve latencies (both sensory and motor) are significantly prolonged in pregnancy when compared with the ulnar nerve latency which remains unaffected by pregnancy. The average sensory NCV of the pregnant females (cases) was found to be less than that of the non-pregnant females (controls) in both ulnar and median nerves but a statistically significant decrease was noted for median nerve only.

This study aims to prevent any functional impairment in the pregnant females due to the median nerve neuropathy and also to improve the quality of life of the pregnant females by early detection, proper diagnosis, complete treatment and prevention of re-occurrence of PRCTS in the pregnant females.

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