

ORIGINAL RESEARCH

Prevalence and Causes of Ulnar Neuropathy in the Electrodiagnosis Clinic of Shohada-e-Tajrish Medical Center

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Abstract: **Background:** The prevalence of ulnar nerve mono neuropathy has increased in recent years. Upper limb involvement by ulnar neuropathy results in motor and sensory disability and this disability imposes significant physical, psychological and financial burdens on patients. We aimed to assess the prevalence and causes of ulnar neuropathy in the Electrodiagnosis clinic of Shohada-e-Tajrish medical center. **Materials and Methods:** In this cross-sectional study we extracted the electronic files of all patients referred to the clinic during 2009-2013. Patients with ulnar neuropathies were selected and required data were obtained. 62 patients with ulnar nerve lesions were included and their data (include age, sex, involved side, cause of lesion, severity and location of involvement) were analyzed. **Results:** Of the 62 patients enrolled, 42(67.7%) were men and 20 (32.3%) were women with a mean age of 41.63 years (range: 17-79 years). There was a significant relationship between age and disease prevalence. The highest prevalence rate of the disease was observed in the 20–39-year-old age group and the lowest in the below 20-year-old age group. Trauma was a more frequent cause than entrapment. Elbow was the most frequent location of injury. **Conclusion:** Ulnar neuropathy was more prevalent in young and middle-aged individuals than those above 60 years. Considering the potential disability caused by this nerve damage, more attention is needed to evaluate patients and initiate proper treatment and rehabilitation in those ulnar nerve lesion.

Keywords: Ulnar neuropathies, Prevalence, Electrodiagnosis

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1. Introduction

The ulnar nerve arises from medial cord of the brachial plexus, passes the medial side of the arm and then the posterior to the medial epicondyle of the humerus at elbow and medial side of the forearm. In the wrist, this nerve passes under the transverse retinaculum through the Guyon's canal of the wrist and enters to the palm of the hand (1-4). Along this way, ulnar nerve is prone to damage by different causes.

Ulnar nerve damage can be caused by the penetrating trauma to the upper limb or can be due to the nerve compression (especially by nerve entrapment). Penetrating trauma (such as entry of sharp objects or a knife) can rupture ulnar nerve at all its way from the armpit to the fingertips. This rup-

ture can be complete or incomplete. The most common site of ulnar nerve rupture is in the lower forearm and wrist area (5-12).

The second mechanism of ulnar nerve injury is compression. Entrapment of ulnar nerve around the elbow (cubital tunnel syndrome) is the most common cause of ulnar compression neuropathy and second most common peripheral nerve entrapment neuropathy in the upper limb (7). This local pressure can result from the flexion of the elbow. Combination of arm abduction, elbow flexion and wrist extension can increase the pressure inside the cubital canal up to six times (2, 3, 13, 14).

Other causes of cubital tunnel syndrome are: adhesive bundles, ulnar bone subluxation on medial epicondyle, cubitus valgus, bony spurs, synovial hypertrophy, tumors, diabetes mellitus, and direct pressure to this area. Occupational activities can also play a predisposing role in cubital tunnel syndrome due to multiple elbow flexion and extension, but a definite relationship between job position and cubital tun-

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nel syndrome has not yet been established (4, 8, 13-20).

The second common location of ulnar nerve entrapment is at wrist area (Guyon's canal syndrome). This can be due to internal and/or external factors; for example pressure from the outside, bone fractures (such as a fracture of hamate hook), direct trauma during repetitive activities at work and ganglia. Several cases of ulnar neuropathy at wrist have even been reported in cyclists due to compression by bicycle handles (21-23).

Ulnar nerve entrapments between elbow and wrist (at forearm) are very rare and can be due to nerve compression by belly of flexor carpi ulnaris muscle or in the depth of the aponeurosis of the pronator teres muscle (10).

The prevalence of ulnar nerve mono neuropathy has increased in recent years. Upper limb involvement by ulnar neuropathy results in motor and sensory disability and this disability imposes significant physical, psychological and financial burdens on the patients (5, 6, 8-10).

Good but insufficient studies have been conducted in this field in Iran and the world, especially on populations with a predisposing factor. In this regard, we can refer to a study in Italy on the prevalence and location of this disorder in patients with type II diabetes mellitus (8). In Iran, in one study, the prevalence of various neurological lesions in professional wrestlers was determined and the extent of ulnar lesions was examined (24).

Therefore, due to the shortcomings in the study of the overall prevalence of ulnar neuropathy in Iran, regardless of underlying disorders or predisposing factors in especial groups, we aimed to assess the prevalence and causes of ulnar neuropathies in the Electrodiagnosis clinic of Shohada-e-Tajrish medical center during 2009-2013.

2. Materials and Methods

In this cross-sectional study we extracted the electronic files of all patients referred to the Electrodiagnosis clinic of Shohada-e-Tajrish medical center during 2009 to 2013 from the archives. Patients with ulnar nerve lesions were selected and required data were obtained. By this method, 62 patients with ulnar neuropathies were included to study and their data (include age, sex, involved side, cause of lesion, severity and location of involvement) were extracted and analyzed.

The age of the patients was analyzed considering the patient's age distribution and incidence of lesions in different age groups (0-19, 20-39, 40-59, and ≥ 60 years). The cause of the lesions was divided into two general groups: lesions caused by trauma and lesions caused by nerve entrapment.

In nerve conduction study and electromyography, we evaluated these parameters regarding ulnar nerves: amplitude and latency of ulnar sensory response from 5th finger and dorsal ulnar cutaneous nerve, amplitude and latency of ulnar mo-

tor response from abductor digiti minimi and 1st dorsal interosseous muscles, ulnar motor nerve conduction velocity at elbow and forearm and needle EMG findings (insertion activity, spontaneous activities, shape and recruitment of motor units) of flexor carpi ulnaris, abductor digiti minimi and 1st dorsal interosseous muscles (8, 25, 26).

Regarding the severity of the lesions, Electrodiagnostic findings (electromyography and nerve conduction study) were used and the severity of the lesions was categorized as mild, moderate, and severe.

Our criteria for severity of ulnar neuropathy were:

Mild ulnar neuropathy: Normal needle electromyography findings in ulnar nerve territory with these abnormalities in nerve conduction study: Detectable ulnar sensory response with decreased amplitude or increased latency and/or decreased motor nerve conduction velocity or increased latency of ulnar motor response without decrement of motor amplitude.

Moderate ulnar neuropathy: Abnormal needle electromyography findings in ulnar nerve territory with these abnormalities in nerve conduction study: Detectable ulnar sensory response with decreased amplitude or increased latency and/or decreased motor nerve conduction velocity or increased latency of ulnar motor response without decrement of motor amplitude.

Severe ulnar neuropathy: Absent ulnar sensory response and/or decreased amplitude of ulnar motor response.

Regarding the site of involvement, considering the high prevalence of lesions in the elbow area, this area was considered as the base and other lesions were divided according to this location (elbow, proximal to the elbow, and distal to the elbow) (9, 26, 27).

Data were analyzed using SPSS software, version 24. Chi-square test was used in analysis.

3. Results

Of the 62 patients enrolled in the study, 42 (67.7%) were men and 20 (32.3%) were women. The mean age of the patients was 41.63 years (range: 17-79 years). Four (6.5%) were in the 0-19 year-old age group, 28 (45.2%) in the 20-39 year-old age group, 17 (27.4%) in the 40-59 year-old age group, and 13 (21%) in the over 60 year-old age group.

With respect to the side of involvement, the right, left, and both sides were involved in 32 (51.6%), 26 (41.9%), and 4 (6.5%) patients, respectively. Moreover, trauma was the cause of lesion in 40 (64.5%) of the patients, while ulnar nerve entrapment was responsible for lesions in 22 (35.5%) of the patients. With respect to the severity of the lesions, 23 (37.1%), 23 (37.1%), and 16 (25.8%) of the patients had mild, moderate, and severe lesions, respectively. The site of the lesion was the elbow in 37 (59.7%) patients, distal to the elbow in

Table 1: Sex distribution in the age groups.

| Age group | Percentage of men to total population of group | Percentage of women to total population of group | Percentage of men to total study population | Percentage of women to total study population | Percentage of men to total male population | Percentage of women to total female population |
|-----------|------------------------------------------------|--------------------------------------------------|---------------------------------------------|-----------------------------------------------|--------------------------------------------|------------------------------------------------|
| 0-19 | 100 | 0 | 6.5 | 0 | 9.5 | 0 |
| 20-39 | 82.1 | 17.9 | 37.1 | 8.1 | 54.8 | 25 |
| 40-59 | 41.2 | 58.8 | 11.3 | 16.1 | 16.7 | 50 |
| Over 60 | 61.5 | 38.5 | 12.9 | 8.1 | 19 | 25 |

Table 2: Cause of the lesions in the age groups.

| Age group | Percentage of trauma | Percentage of nerve entrapment |
|-----------|----------------------|--------------------------------|
| 0-19 | 100 | 0 |
| 20-39 | 78.6 | 21.4 |
| 40-59 | 44.4 | 55.6 |
| Over 60 | 50 | 50 |

Table 3: Severity of the lesions in the age groups.

| Age group | Percentage of mild cases | Percentage of moderate cases | Percentage of severe cases |
|-----------|--------------------------|------------------------------|----------------------------|
| 0-19 | 50 | 50 | 0 |
| 20-39 | 28.5 | 35.7 | 35.7 |
| 40-59 | 47.1 | 29.4 | 23.5 |
| Over 60 | 38.5 | 46.2 | 15.4 |

Table 4: The results of Chi-square test in measuring the relationship between the variables.

| Effective variables | Chi-square | Degrees of freedom | Significance level |
|---------------------|------------|--------------------|--------------------|
| sex | 7.806 | 1 | 0.005 |
| age | 19.161 | 3 | 0.000 |
| cause of the lesion | 5.226 | 1 | 0.022 |

Table 5: Observed frequency and expected variables (sex, age, cause of the lesion) of the populations and the prevalence rate of the disease in groups.

| Effective variables | Different values of variables | Observed | Expected | Difference |
|---------------------|-------------------------------|----------|----------|------------|
| Sex | male | 42 | 31 | 11 |
| | female | 20 | 31 | -11 |
| Age | <20 | 4 | 15.5 | -11.5 |
| | 20-39 | 28 | 15.5 | 12.5 |
| | 39-50 | 17 | 15.5 | 1.5 |
| | >50 | 13 | 15.5 | -2.5 |
| Cause of the lesion | trauma | 40 | 31 | 9 |
| | nerve entrapment | 22 | 31 | -9 |

20 (32.3%) patients, and proximal to the elbow in 5 (8.1%) patients.

About sex distribution in the age groups, all four people in the 0-19 year-old age group were male which comprised 9.5%



of all men and 6.5% of the total study population. In total, 9.5% of the men and 0% of the women in the study were in this age group. In the 20-39 year-old age group, 23 (82.1%) were men (comprising 37.1% of the total study population) and 5 (17.9%) were women (comprising 8.1% of the total study population). In total, 54.8% of the men and 25% of the women in the study were in this age group. In the 40-59 year-old age group, 7 (41.2%) were men (comprising 11.3% of the total study population) and 10 (58.8%) were women (comprising 16.1% of the total study population). In total, 16.7% of the men and 50% of the women in the study were in this age group. In the over 60-year-old age group, 8 (61.5%) were men (comprising 12.9% of the total study population) and 5 (38.5%) were women (comprising 8.1% of the total study population). In total, 19% of the men and 25% of the women in the study were in this age group. (Table 1)

With respect to the cause of the lesions and severity of lesions in age groups, in the 0-19 year-old age group, all 4 (100%) patients had trauma. In this group, 2 (50%) had mild involvement and 2 (50%) had moderate involvement. In the 20-39 year-old age group, 22 (78.6%) injured by trauma, while 6 (21.4%) had ulnar nerve entrapment. In this group, 8 (28.5%), 10 (35.7%), and 10 (35.7%) had mild, moderate, and severe involvement, respectively. In the 40-59 year-old age group, 8 (44.4%) were injured by trauma, while 10 (55.6%) had ulnar nerve entrapment. In this group, 8 (47.1%), 5 (29.4%), and 4 (23.5%) had mild, moderate, and severe involvement, respectively. Moreover, in the over 60-year-old age group, 6 (50%) were injured by trauma, while 6 (50%) had ulnar nerve entrapment. In this group, 5 (38.5%), 6 (46.2%), and 2 (15.4%) had mild, moderate, and severe involvement, respectively (Tables 2 and 3).

In patients with trauma, 13 (32.5%), 12 (30%), and 15 (37.5%) patients showed mild, moderate, and severe forms of peripheral ulnar nerve injury, respectively. In patients with nerve entrapment, 11 (50%), 10 (45.4%), and 1 (4.6%) patient had mild, moderate, and severe forms of peripheral ulnar nerve involvement, respectively.

In male patients, trauma was responsible for injuries in 32 (78%) of the patients, while nerve entrapment was the cause of lesions in 9 (22%) patients. In female patients, trauma was responsible for injuries in 8 (38%) of the patients, while nerve entrapment was the cause of lesions in 13 (62%) patients.

In male patients, 12 (28.6%), 17 (40.5%), and 13 (31%) patients had mild, moderate, and severe lesions, respectively. In female patients, 11 (55%), 6 (30%), and 3 (15%) patients had mild, moderate, and severe lesions, respectively. We used Chi-square test to analyze data. The results are shown in table 4. Table 5 shows the observed and expected frequencies of sex, age, and cause of the lesion in the populations and difference between them and the prevalence rate of the disease in groups.

According to tables 4 and 5, and the results of Chi-square test, the significance level of Chi-square test for sex was 0.005 which is less than alpha error of 0.05. This indicates that Chi-square test was significant at a confidence level of 95% and there was a significant relationship between sex and disease prevalence. According to the observed frequencies, the prevalence rate of the disease among men was more than women.

According to tables 4 and 5, and the results of chi-square test, the significance level of Chi-square test for age was 0.000 which was less than alpha error of 0.05. This indicates that Chi-square test was significant at a confidence level of 95% and there was a significant relationship between age and disease prevalence. According to the observed frequencies, the highest prevalence rate of the disease was observed in the 20-39 year-old age group and the lowest in the below 20-year-old age group.

As shown in tables 4 and 5, and the results of Chi-square test, the significance level of Chi-square test for the cause of the lesion was 0.022 which was less than alpha error of 0.05. This indicates that Chi-square test was significant at a confidence level of 95% and there was a significant relationship between the cause of the lesion and disease prevalence. According to the observed frequencies, the prevalence of the disease due to trauma was higher than the nerve entrapment.

4. Discussion

In this study, 62 patients with confirmed ulnar nerve lesion were statistically analyzed and significant differences among variables including sex, age, and the cause of the lesion were reported.

The rate of the ulnar nerve lesion was higher among men than women (42 patients were men and 20 were women). In other studies, ulnar neuropathy was reported more prevalent in men than women as in our study. In the Finnish population between 2007 and 2016, the total crude incidence rates per 100 000 person-years among women and men were 25.8 and 36.0 for ulnar entrapment neuropathies (28). In a study in Italy, sex incidences of ulnar neuropathy at the elbow were 32.7 for men and 17.2 for women (29). Other studies on ulnar neuropathy at the elbow have also reported this gender-related difference (25, 30-34). Both non-traumatic and traumatic injuries were more common among men rather than women (35, 36). This difference can be due to more heavy work and higher rate of trauma in men than women.

The mean age of the patients was 41.63 years and age of 51.7% of the patients was between 17 and 39 years and the age of 79% of the patients was less than 60 years. In another study in Iran, the mean age of patients with ulnar neuropathy was 46.5 years (26), which was nearly similar to our study. However, in a study in Siena (Italy), the mean age of

the patients was 56 years, which significantly more than our study (29). This difference between Italian study and Iranian studies; can be due to inclusion of traumatic cases in Iranian studies (compared with only non-traumatic cases in the Italian study) or can be attributed to lower mean age of the Iranian general population compared with the mean age of the general population of Siena.

The 20-39 year-old age group had the highest prevalence rate of the lesion, mostly due to trauma and the most severe cases in this study were among this age group which was caused by trauma (15 of 16 of all severe cases equal to 93.75% of all severe cases were in this age group and all 15 cases were due to trauma). Inconsistent with our findings, in Finland and Italy, incidence of ulnar neuropathy increased by age and this neuropathy was more prevalent in the elderly (In Finland maximal incidence was in 50-59 years old group) (28, 29). This difference was related to difference in the studied groups. In another study, the mean age of traumatic patients was significantly lower than non-traumatic patients (26); and in our study, trauma was the cause of ulnar neuropathy in 64.5% of the cases (unlike studies in Italy and Finland which were often non-traumatic). With attention to this point, we expect this difference in age of patients between our study and studies in Finland and Italy. The higher prevalence of injury in young persons in our study is probably due to more prevalent dangerous actions in this age group (especially in young men) during work and recreational activities and subsequent traumatic ulnar nerve injuries by accidents. We should consider that young persons are a productive group in the community and ulnar nerve injury as a disabling lesion can cause handicap in these patients and has significant financial burden on patient, his/her family and community. This indicates that prevention of these lesions in young persons has economical significance.

In our study, trauma as the cause of ulnar nerve injury was more prevalent than entrapment. (Lesions in 40 patients were due to trauma, but due to entrapment in 22 patients). This difference in men was more prominent than women (In male patients, trauma was responsible for injuries in 78% of patients; but in female patients, trauma was responsible for injuries in 38% of patients). This suggests that men engage more in dangerous actions and prevention of trauma in these actions (especially in work places and during vehicle accidents) can significantly reduce ulnar nerve injury in the community, and the best way to prevent these lesions or reduce the damages is applying the safety regulations during work, vehicles driving or daily activities. Also, with attention to this finding, in cases of trauma, neurological examination should be performed accurately and quickly to take appropriate action and minimize the injury and this neurological examination should be performed at follow-up visits. Severe ulnar nerve injury in traumatic cases was more preva-

lent than in entrapment cases (in traumatic cases 37.5% were severe, but in entrapment cases only 4.6% were severe). In one study, in traumatic cases 41.3% were severe, but in non-traumatic cases only 9.9 % were severe (26). This emphasizes the importance of preventing traumatic nerve lesions.

The most common site of ulnar neuropathy was the elbow (59.7% of cases). Findings of other studies were similar to our study (25-28, 30, 33, 34, 37). This is due to the anatomic position of ulnar nerve at the elbow. Ulnar nerve is superficial and in a small space at the elbow, near bones, without sufficient protective soft tissue around it. These conditions predispose ulnar nerve to injury at elbow.

In the future, further studies with larger statistical community are recommended locally and nationally, to investigate prevalence of ulnar neuropathies and the causes and location of them in different sex, age and work groups and to find the best methods for prevention of these lesions.

4.1. Positive points and limitations of our study

There are few studies about demographic characteristics of ulnar neuropathy in Iran. We evaluated these characteristics in this study and our results can be used by Iranian physicians and policy makers of Iran health system. Our data was obtained retrospectively from a data source, which decreases trust to data. Electrodiagnosis studies in our data source were obtained by more than one specialist. This can conclude heterogeneity in taking history and physical examination and interpretation of Electrodiagnostic findings. Unfortunately, some data about risk factors of ulnar neuropathy, such as history of diabetes mellitus and hypothyroidism, skeletal deformities such as cubitus valgus and patients' job were not available in our data source and we could not consider these parameters in our study.

5. Conclusion

This study showed that ulnar neuropathy was more prevalent in young and middle-aged people (under 60 years) than older individuals (above 60 years); men are more involved than women; the main cause of ulnar nerve injury is trauma and main site of this injury is at elbow. With attention to potential disability caused by this nerve damage, more attention is needed to evaluate patients and initiate proper treatment and rehabilitation in patients with ulnar neuropathy.

6. Appendix

6.1. Acknowledgment

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6.2. Conflict of interest

Authors declare no conflict of interest.



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6.4. Author's contributions

All the authors have the same contribution.

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