

## Functional and Structural Neurological and Vascular Lesions in Short- and Long-Term Hemodialyzed Patients

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### Abstract

In patients with short- and -long term hemodialysis treatment several functional and structural neurological and vascular lesions are present that may be dependent on several factors: duration of hemodialysis treatment, age, blood pressure associated with ventricular hypertrophy, extensive vascular calcifications, arrhythmias. Besides these all patients were evaluated for several clinical data: survival, rehabilitation, nutritional status, anemia, blood pressure, mild-to-moderate ventricular hypertrophy, arrhythmias, uremic polyneuropathy (UNP), extensive vascular calcifications, hypoacusis from cochlear neurosensory, presence of carpal tunnel syndrome.

### Introduction

Hemodialysis treatment of short- and mainly of long-duration is associated with several neurological and vascular functional and/or structural alterations that are dependent on duration of hemodialysis treatment, age of patients, presence of high blood pressure that is associated with mild-to-moderate ventricular hypertrophy, vascular calcification, presence of extensive polyneuropathy, associated with hearing loss. A rigorous analysis and control of these clinical data may be useful to improve the conditions of the patients and increase their survival.

In 1995 about more than 25 years from the introduction of regular hemodialysis treatment for patients with end-stage renal disease we performed a careful investigation of clinical conditions of patients on long-term maintenance hemodialysis in a cohort of 24 of 116 patients with average duration of treatment of  $222 \pm 23$  months. The following data were evaluated in these 24 patients: actuarial survival that was 72% at 10 years and 43% at 20 years. The rehabilitation of 24 survivors was rather good: 13 were able to work, 8 were retired or unable to work, and 3 were able to care for most personal needs. The nutritional status was well preserved. Anemia was improved with increase of Hb from  $23 \pm 7$  at the start of treatment to  $31 \pm 8$  at last observation without therapy with erythropoietin. Blood pressure was normal in 18 patients and high in 6 patients who showed an association with mild-to-moderate ventricular hypertrophy. Supraventricular arrhythmias were detected by Holter monitoring in 41% and ventricular arrhythmias in 35%. Extensive vascular calcifications were present in 100% of patients in the abdominal aorta, but only 4 patients showed clinical signs of peripheral vascular disease. Bone histology valuable only in 20 patients showed no bone lesions in 1 case (5%), mild mixed osteodystrophy in 3 cases (15%) advanced mixed osteodystrophy

in 5 cases (25%). Uremic polyneuropathy (PNP) is present in patients with short- and long-term hemodialysis (RDT) and its severity may be evaluated by measurement of 20 electrophysiological parameters according to the Bolton classification (); these parameters are able to assess the presence and the degree of Peripheral Neuropathy (PNP). Subsequently we evaluated the severity of PNP in 135 patients treated by hemodialysis for 2-184 months. The patients were divided into 3 groups according to the duration of RDT (group 1°: 52 patients with less than 5 years of RDT; group 2°: 46 patients with 5 to 10 years of RDT; group 3°: 37 patients with 10 to 15 years of RDT. Each group was then divided into 2 subgroups according to age (less or more than 47 years) to evaluate also the influence of age on PNP.

The presence of clinical PNP was evaluated according to the Bolton classification: in group 1°, 50% of patients have mild PNP; in group 2°, 45.7% of patients have mild PNP; in group 3°, 81.1% have mild PNP, 10.8% have moderate PNP and 2.7% have severe PNP. In as many as 84.4% of the 135 patients at least one of the 20 parameters studied had abnormal values and in 63% two or more parameters were abnormal: of 20 parameters evaluated separately in the 3 groups only three showed abnormal mean values: sural nerve latency in all 3 groups; sural nerve Sensory Conduction Velocity (SCV) and peroneal nerve maximal Motor Conduction Velocity (MC) in group 3°. Five parameters referring to ulnar nerves and two referring to sural nerve were significantly more impaired in the group of patients with the longest duration of RDT and in this group the impairment was more severe in older patients. Ulnar nerve MCV was significantly more impaired in patients with higher levels of PTH. In summary long term dialysis treatment does not prevent persistence of mild signs of PNP, which is worse in

patients with more than 10 years of RDT and older more than 47 years. Another neurological dysfunction in regular hemodialysis treatment is hearing loss that has been described in patients with chronic renal failure on Regular Dialysis Treatment (RDT) with very different frequency, ranging from 20 to 75%. RDT does not seem to worsen hearing function for at least the 5 years of treatment; no studies are available on patients on RDT for more than 10 years. We performed an audiometric evaluation in 91 patients on RDT for various periods: group 1° (34 patients: < 5 years), group 2° (32 patients: 5-10 years), group 3° (25 patients: ≥ 10 years). Patients with histories of chronic otitis, ototoxic drug treatment and chronic auditory trauma were excluded. Hearing loss was present in 77% of patients and 69.2% of ears; group 3° (25 patients ≥10 years). The percentage of patients with hypoacusis was higher in group 3° (84%), than in group 1° (76.3%) and group 2° (71.7%) but the differences were not statistically significant. Hypoacusis was cochlear neurosensory in 61.5%, conductive in 6.5% and mixed in 9% of patients- The percentage of patients with cochlear neurosensory hypoacusis was similar in the 3 groups (1°: 61.7%, 2°: 59.3%, group 3°: 64%). Hearing loss was of slight to moderate degree and not different in the 3 groups (1°: 22,7 ±15 dB%), group 2°: 26.9±6.0 dB), Group 3°: 29.1±8.9 dB).

In conclusion hearing loss, mainly cochlear neurosensory is present in a high percentage of patients in RDT even at the beginning of treatment, but no negative effects on hearing can be correlated with the duration of hemodialysis. One structural alteration in patients with short- and long- term hemodialysis is also the presence of Carpal Tunnel Syndrome (CTS) that is a canalicular mononeuropathy produced by compression of the median nerve at the wrist in its course through the so-called carpal tunnel. In the recent years there have been numerous reports of a higher incidence of CTS in the chronic hemodialyzed patients with “entrapment” of peripheral nerves of the upper limb. CTS has been reported with a varying frequency ranging between 4% to 17% in patients not selected according to dialytic age. In patients with more than 5 and 10 years of RDT the frequency of CTS is approximately 50%. For the

pathogenesis of CTS in dialyzed patients more importance was attributed to the presence of a functioning vascular access, but CTS may also develop in limbs which never undergone a vascular access.

## Conclusion

This analysis of patients with short- and long-term hemodialysis showed the presence of neurological and vascular functional and structural alterations that may be dependent on several factors: duration of hemodialysis treatment, age, blood pressure associated with ventricular hypertrophy, extensive vascular calcifications, arrhythmias. In all patients were also evaluated several clinical data: survival, rehabilitation, nutritional status, anemia, blood pressure, mild-to-moderate ventricular hypertrophy, arrhythmias, uremic polyneuropathy (PNP), extensive vascular calcifications, hypoacusis from cochlear neurosensory, presence of carpal tunnel syndrome.

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