

VIBRATION SENSORY THRESHOLD: A GUIDE TO ADEQUACY OF DIALYSIS?

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Summary

The vibration sensory threshold (VST) is an easy non-invasive reproducible and sensitive bedside test of peripheral nerve function. It is impaired in pre-dialysis uraemic patients with no clinical evidence of peripheral neuropathy; tends to deteriorate during the first year of dialysis after which it remains relatively constant, and returns towards normal within one week of kidney allograft function. It is unrelated to type of dialysis, acetylator status, average serum creatinine values or serum aluminium. VST may be a valuable monitor of the adequacy of dialysis.

Introduction

A symptomatic peripheral neuropathy as shown by decreased mean motor nerve conduction velocity studies (MNCV) occurs in at least 50 per cent of patients in end-stage renal failure or on replacement dialysis treatment [1], can be loosely correlated with decrease in renal function and is improved by long term intermittent haemodialysis [2]. Clinically, loss of vibration sense is the earliest finding in uraemic neuropathy [3] and may ante-date changes in MNCV which is a relatively insensitive measurement of nerve dysfunction. The Biothesiometer (Bio-medical Instrument Company, Newbury, Ohio, USA) is an inexpensive machine producing vibration of constant frequency and variable reproducible amplitude enabling rapid non-invasive bedside estimation of vibration sensory threshold (VST): it has proved valuable in monitoring treatment of diabetes mellitus [4] and multiple sclerosis [5]. We have investigated its use in uraemia.

Method

VST was measured at four sites; radial styloid and medial malleolus on each side, and three readings at each site were used to obtain upper and lower limb means.

The Biothesiometer probe was allowed to rest under its own weight at right angles to the part tested and the amplitude of vibration increased until just perceived.

Four groups of patients were studied:

- (i) Fifty-three long term dialysis patients (43 on haemodialysis (HD) and 10 on peritoneal dialysis (PD)).
- (ii) Eighteen uraemic patients awaiting dialysis (creatinine values between 300 and 1200 $\mu\text{mol/L}$).
- (iii) Twenty-one transplanted patients, nine of whom were studied from the day of transplantation.
- (iv) Forty-three controlled patients of a similar age and sex distribution to the dialysis group, taking similar drugs (mostly anti-hypertensives and beta-blockers) and with normal renal function.

Group (i) was studied twice at an interval of 12 to 15 months. Twenty-four of these remained on HD and six on PD; seven patients changed from HD to PD and three from PD to HD; nine were transplanted and four patients died. Patients with diabetes mellitus or multisystem disorders were excluded. Acetylator status was measured in 43 patients and serum aluminium levels in 46. No patient had neuropathic symptoms or signs other than diminished or absent ankle tendon reflexes in some of the more elderly patients. Parametric statistical analysis included Student's paired and un-paired t tests and linear correlation. Results are expressed as the mean \pm 1 standard deviation.

Results

Changes in VST were more marked in the lower than upper limbs and only these have been analysed. VST in the control patients was closely age correlated (correlation coefficient 0.77), with a mean of 7.8 ± 3.2 VST units. Mean actual VST values for each of the pre-dialysis, HD, PD and transplant groups are illustrated in Figure 1. Age corrected VST for each of these groups (with actual values in parenthesis) are as follows: pre-dialysis 8.4 (22.3); HD 8.2 (16.3); PD 10.0 (13.4); transplant 7.6 (10). It can be seen that uraemia is associated with a highly significant increase in VST compared with normal ($p < 0.001$) and that transplantation returns the value towards normal compared with haemodialysis patients ($p < 0.005$). In eight patients a single haemodialysis did not alter VST. In 21 successfully transplanted patients VST was not significantly different from normal. Eight of the nine patients studied from the day of transplantation showed rapid return of VST within three to five days of kidney allograft function, to values within the normal range which were then maintained ($p < 0.005$). The ninth patient (a 64 year old man) showed similarly rapid improvement to lower though not normal values. Twenty-seven of the 43 dialysis patients studied were slow acetylators and 16 fast, with a similar age and sex distribution. VST was not significantly different between these two groups. Neither serum aluminium concentrations (in 46 patients) nor mean pre-dialysis creatinine concentrations were related to VST levels. Figure 2 shows

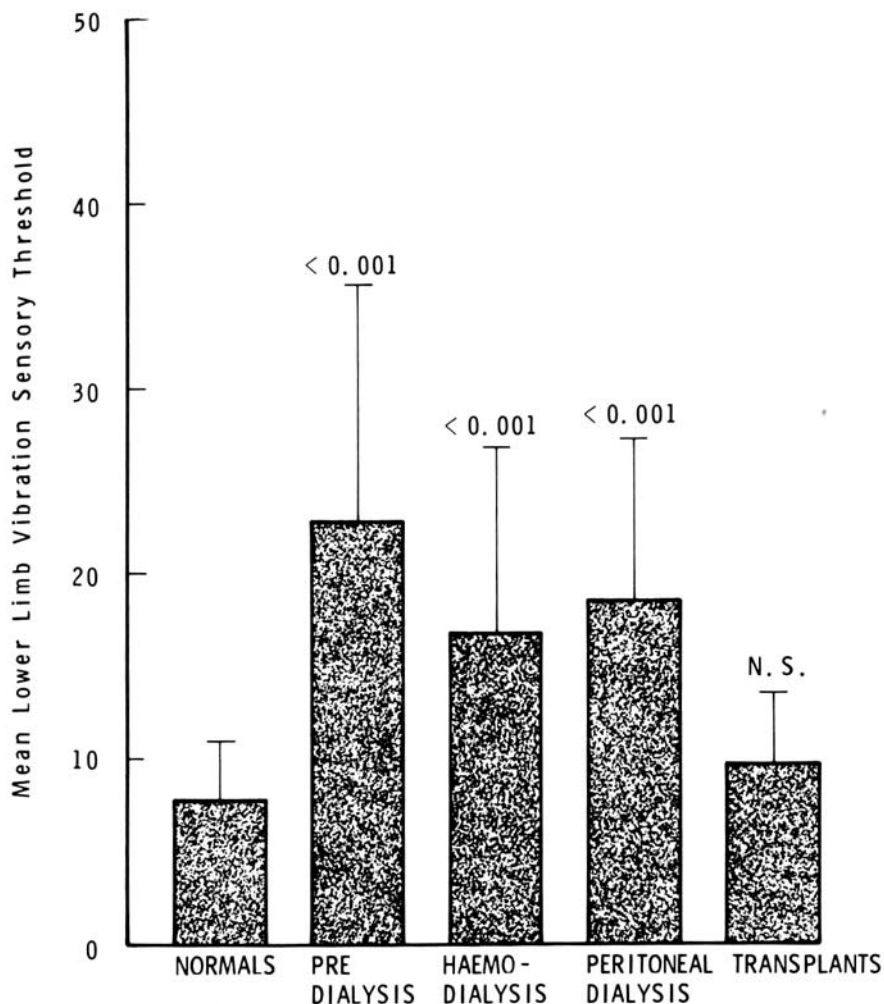


Figure 1

the change in VST over 12 months in the two dialysis groups in which this was possible; both deteriorated ($p < 0.005$). In the seven patients changing from HD to PD, VST did not alter over 12 months, but in the three changing from PD to HD (all because of peritonitis) there was a significant deterioration ($p < 0.005$).

Discussion

Quantitative clinical assessment of the adequacy of dialysis is difficult and the effect of uraemia on nerve function, if easily and reliably measurable, would seem to be a reasonable parameter to use. Haemodialysis is known to alleviate sympto-

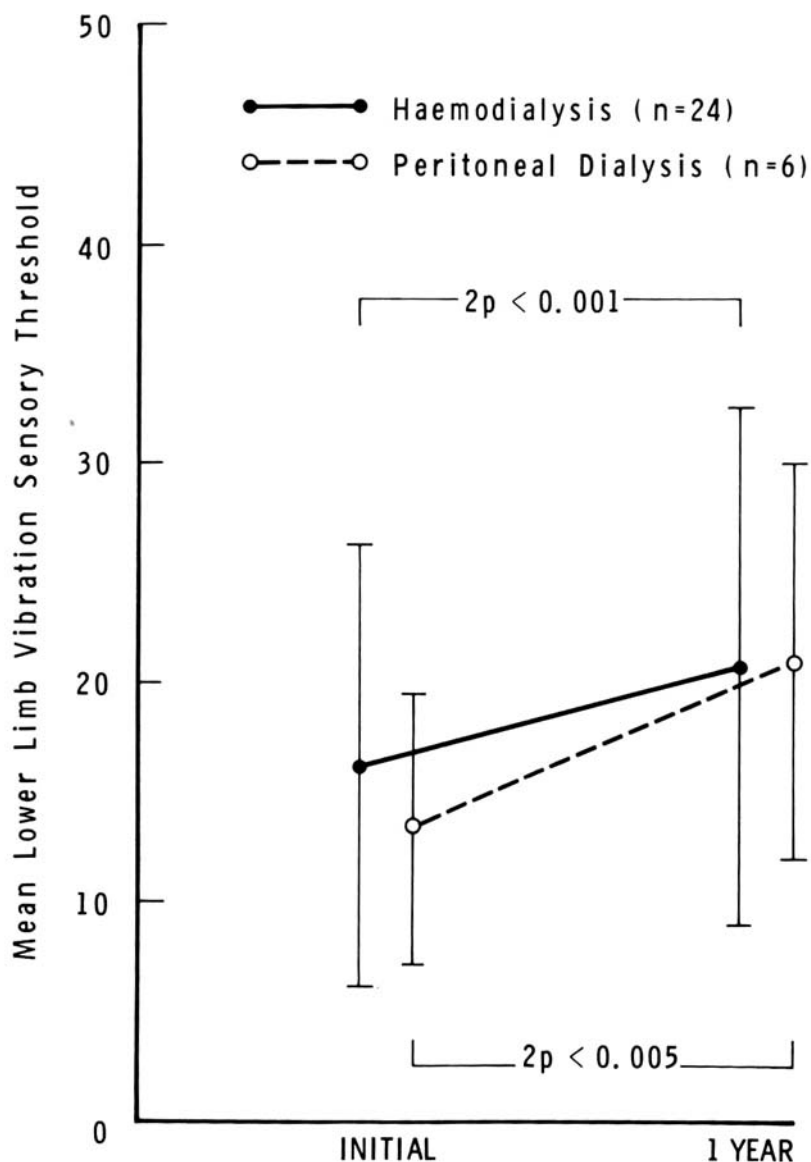


Figure 2

matic neuropathy [6] but MNCV is not demonstrably worsened by inadequate haemodialysis [7], though it may be improved by haemofiltration [8]. MNCV studies are tedious and time consuming to perform; are a relatively insensitive measure of nerve function; require relatively immovable expensive apparatus demanding great skill to use; and unless standard recording conditions can be guaranteed are of limited use for reproducible longitudinal studies. VST measure-

ment is easy and quick to perform at the bedside, requires little skill or training, and is reproducible. This study confirms the observations of Nielsen [9] that VST is abnormal in uraemic patients and returns towards normal with successful transplantation [10]. We have shown that impairment of VST is an early feature of uraemia and shows a trend to deterioration after a year on dialysis with no difference between those on peritoneal or haemodialysis. VST was abnormal in 77 per cent of our patients despite the absence of any clinical symptoms or signs of neuropathy. Like similarly simple tests of autonomic nerve function [11] it seems ideal for repeated sequential studies of uraemic nerve dysfunction in response to different treatment schedules [12].

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