

AMBULATORY RECORDING OF WAVE REFLECTIONS AND ARTERIAL STIFFNESS DURING INTRA- AND INTERDIALYTIC PERIODS IN END-STAGE RENAL DISEASE PATIENTS UNDER HEMODIALYSIS

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BACKGROUND/AIMS: Elevated wave reflections and arterial stiffening are strong predictors of cardiovascular morbidity and mortality in hemodialysis patients [1,2]. Previous studies investigating arterial cushioning function in these individuals were based only on office measurements obtained shortly before or after the hemodialysis procedure [3,4]. The aim of this study was to investigate potential variations in wave reflection and arterial stiffness parameters during the intra- and inter-dialytic periods over a 48-hour period in chronic hemodialysis patients.

MATERIAL AND METHODS: A total of 92 hemodialysis patients underwent a 48-hour brachial and aortic ambulatory blood pressure monitoring (ABPM) with the use of the newly commercially available Mobil-O-Graph device (IEM, Stolberg, Germany). ABPM included a whole 4-hour hemodialysis session and the subsequent 44-hour interdialytic interval. Mobil-O-Graph is a novel validated brachial cuff-based automatic oscillometric device, which additionally records in ambulatory conditions pulse waveforms at brachial artery and assesses wave reflection and arterial stiffness (Pulse Wave Velocity, PWV) via mathematical transformation [5]. Statistical analysis was performed with the Statistical Package for Social Sciences (SPSS 17.0) for Windows XP. Comparison of BP measurements between the dialysis and out-of-dialysis periods of hemodialysis-on day (Day 1) as well as between the out-of-dialysis periods of Day (1) and the hemodialysis-off day (Day 2) were performed with the paired samples Student's t-test.

RESULTS: Baseline characteristics of study participants are depicted in Table 1. As shown in Table 2 and Figure 1a, in hemodialysis-on day (Day-1) mean augmentation index (Alx), heart rate-adjusted Alx (Alx(75)), wave reflection magnitude and cardiac index were significantly lower during the intradialytic period than during the out-of-dialysis period. In contrast, PWV and total vascular resistance did not significantly differ between the intradialytic and out-of-dialysis intervals of the hemodialysis-on day (9.29±2.4 vs 9.27±2.5 m/sec, P=0.679 for PWV and 1.28±0.2 vs 1.27±0.2, P=0.338 for total vascular resistance, respectively). As shown in Table 3 and Figure 1b, Alx, Alx(75) and wave reflection magnitude were significantly elevated during the 24-hour period of the hemodialysis-off day (Day 2) as compared to the out-of-dialysis period of the hemodialysis-on day. Similarly, PWV and total vascular resistance exhibited a slight but significant elevation between the out-of-dialysis periods of Day (1) and Day (2) (Table 3).

CONCLUSIONS: This study shows a gradual interdialytic increase in arterial wave reflections along with a slight and potentially BP-dependent elevation in arterial stiffness during the interdialytic period in hemodialysis patients.

REFERENCES

- Blacher J, Guerin AP, Pannier B et al. Impact of aortic stiffness on survival in end-stage renal disease. *Circulation* 1999; 99: 2434–2439
- London GM, Blacher J, Pannier B et al. Arterial wave reflections and survival in end-stage renal failure. *Hypertension* 2001; 38: 434–438
- Georgianos PI, Sarafidis PA, Malindretos P et al. Hemodialysis reduces augmentation index but not aortic or brachial pulse wave velocity in dialysis-requiring patients. *Am J Nephrol* 2011; 34: 407–414
- Di Iorio B, Nazzaro P, Cucciniello E et al. Influence of haemodialysis on variability of pulse wave velocity in chronic haemodialysis patients. *Nephrol Dial Transplant* 2010; 25: 1579–1583
- Weber T, Wassertheurer S, Rammer M, Maurer E, Hametner B, Mayer CC, Kropf J, Eber B. Validation of a brachial cuff-based method for estimating central systolic blood pressure. *Hypertension* 2011; 58: 825–32

Table 1: Baseline characteristics of study participants.

N	92
Gender (M/F)	54/38
Age (years)	62.6 ± 15.1
Dry weight (kg)	72.2 ± 15.5
BMI (kg/m ²)	25.9 ± 4.9
Cause of ESRD	
Diabetes Mellitus	23/92, 25.0%
Glomerulonephritis	12/92, 13.0%
Hypertension	8/92, 8.7%
Polycystic kidney disease	6/92, 6.5%
Obstructive nephropathy	4/92, 4.4%
Other	6/92, 6.5%
Unknown	33/92, 35.9%

Table 2. Comparison of wave reflection and arterial stiffness parameters during the hemodialysis-on day (Day 1) between the dialysis and out-of-dialysis periods (m±SD).

Parameter	Dialysis period	Out-of-dialysis period	P
Alx (%)	25.6 ± 10.4	27.1 ± 9.4	<0.05
Alx(75) (%)	25.0 ± 9.1	27.0 ± 7.8	<0.01
Reflection magnitude (%)	62.1 ± 6	64.6 ± 4.4	<0.001
PWV (m/sec)	9.29 ± 2.4	9.27 ± 2.5	0.679
Total vascular resistance (s*mmHg/ml)	1.28 ± 0.2	1.27 ± 0.2	0.338
Cardiac output (l/min)	5.0 ± 0.6	4.9 ± 0.6	0.263
Cardiac index (l/min*/m ²)	11.0 ± 7.2	12.3 ± 6.7	<0.05

Table 3. Comparison of wave reflection and arterial stiffness parameters between out-of-dialysis periods of Day (1) and Day (2) of the 48-hour ABPM (m±SD).

Parameter	Out-of-dialysis period		P
	Day (1)	Day (2)	
Alx (%)	27.1 ± 9.4	29.3 ± 10.0	<0.001
Alx(75) (%)	27.0 ± 7.8	28.0 ± 8.4	<0.05
Reflection magnitude (%)	64.6 ± 4.4	65.5 ± 4.2	<0.01
PWV (m/sec)	9.27 ± 2.5	9.40 ± 2.5	<0.001
Total vascular resistance (s*mmHg/ml)	1.30 ± 0.2	1.27 ± 0.2	<0,01
Cardiac output (l/min)	4.92 ± 0.6	4.9 ± 0.6	0.860
Cardiac index (l/min*/m ²)	12.3 ± 6.7	14.0 ± 7.1	<0,001

Figure 1. Comparison of Alx(75) a) between the dialysis and out-of-dialysis periods of Day (1) and b) between Day (1) and Day (2).

