

CHANGES IN PULSE WAVE AT THE STARTUP AND AT THE TERMINATION OF HEMODIALYSIS SESSION

Authors: Malgorzata Debowska¹, Alicja Wojcik-Zaluska², Wojciech Dabrowski³, Jan Poleszczuk¹, Andrzej Ksiazek⁴, Wojciech Zaluska⁴, Jacek Waniewski¹

¹Institute of Biocybernetics and Biomedical Engineering, Polish Academy of Sciences, Department for Mathematical Modeling of Physiological Processes, Warsaw, POLAND

²Medical University of Lublin, Department of Physical Therapy and Rehabilitation, Lublin, POLAND

³Medical University of Lublin, Department of Anesthesiology and Intensive Therapy, Lublin, POLAND

⁴Medical University of Lublin, Department of Nephrology, Lublin, POLAND

OBJECTIVES

Hemodialysis (HD), including its extracorporeal circuit and fast removal of water from blood, substantially disturbs body homeostasis. We aimed to investigate the changes in pulse wave propagation and hemodynamics of cardiovascular system at the startup and at the termination of HD session.

METHODS

Twelve stable prevalence HD patients (50% females, age 61 ± 13 year, body weight 69 ± 16 kg) were checked in respect of the changes in pulse wave and hemodynamics of cardiovascular system before and after the start, as well as before and after the end of HD session (duration 243 ± 13 min, blood flow 294 ± 52 mL/min, ultrafiltration 2.2 ± 0.99 L). The pressure waveform at the ascending aorta and parameters of both peripheral and central pulse waves were derived from an external measurement taken at the radial artery using applanation tonometry (SphygmoCor, AtCor Medical, Australia). Hemodynamic parameters were assessed by the impedance cardiograph (PhysioFlow, Manatec, France).

RESULTS

- Radial and aortic systolic (SP) and diastolic (DP) blood pressures decreased after the onset of HD session and increased during the termination of HD session, Table 1, Figure 1.
- The peak of the primary left ventricular ejection pressure (P1) and the peak of the arterial reflection wave (P2) were changed after the start and after the end of HD session, but the startup and the termination of HD did not have an impact on the occurrence times of P1 and P2 (T1 and T2, respectively), Table 1, Figure 1.
- The change in the augmentation index, the measure of wave reflection and arterial stiffness, was not observed, Table 1.
- The startup of HD increased the period of pulse wave; ejection duration (ED) remained unchanged, but diastolic duration (DD) increased after the start of HD session, Table 1.
- Hemodynamic parameters: stroke volume, cardiac output, ventricular ejection time, early diastolic filling ratio, left cardiac work index, systemic vascular resistance, end diastolic volume and ejection fraction remain unchanged at startup and stopping of HD session.

Table 1. Aortic pulse wave parameters

	Before start	After start	Before end	After end
SP, mmHg	126 ± 17	$113 \pm 15^{***}$	108 ± 19	$117 \pm 14^*$
DP, mmHg	78 ± 8	$71 \pm 6^{**}$	71 ± 10	73 ± 10
P1, mmHg	111 ± 13	$101 \pm 11^{***}$	97 ± 14	$106 \pm 14^{**}$
P2, mmHg	126 ± 17	$113 \pm 15^{***}$	110 ± 19	$117 \pm 14^*$
T1, ms	114 ± 14	117 ± 11	117 ± 41	120 ± 34
T2, ms	223 ± 29	227 ± 30	205 ± 26	215 ± 27
AI	150 ± 31	149 ± 28	147 ± 32	137 ± 24
PERIOD, ms	850 ± 109	$895 \pm 124^{**}$	849 ± 114	864 ± 109
ED, ms	312 ± 39	314 ± 40	284 ± 31	293 ± 29
DD, ms	538 ± 102	$582 \pm 110^*$	564 ± 100	571 ± 90

p-value: *** < 0.001; ** < 0.01; * < 0.05; after vs. before

CONCLUSIONS

The startup and the termination of hemodialysis session have an impact on the pulse wave amplitude and period (peripheral and central) but not on the occurrence time of the characteristic waveform points. Hemodynamic parameters of cardiovascular system remained unchanged throughout the startup and the termination of hemodialysis.

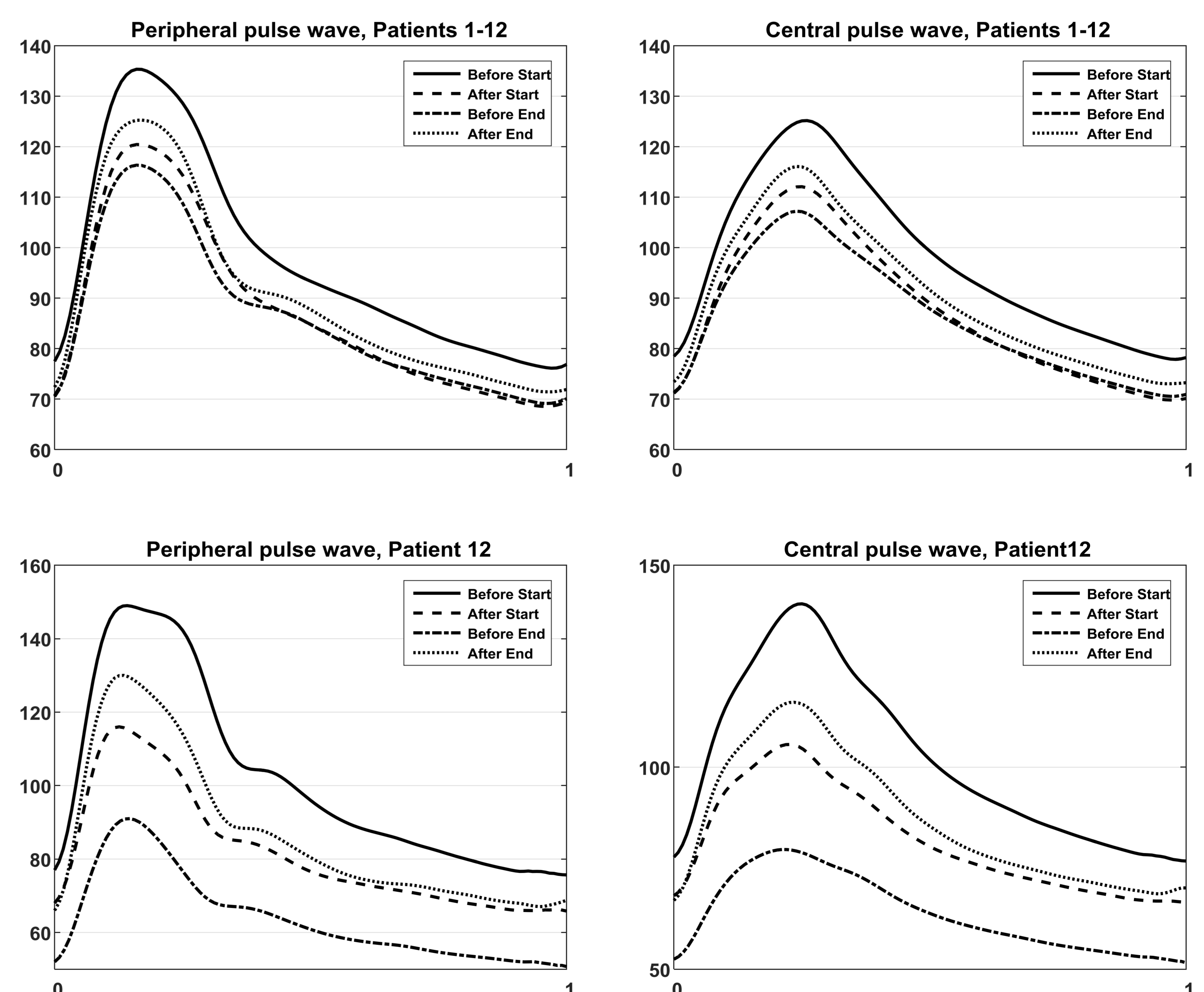


Figure 1. Mean (top panel) and exemplary (bottom panel) peripheral and central pulse waves before and after start as well as before and after the end of HD session versus time normalized to pulse period.

