

Prognostic Significance of Hemodynamic Parameters in Hemodialysis Patients

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Purpose:

Hemodialysis (HD) patients have a high mortality that mainly results from cardiac impairment. Using an ultrasound dilution device various hemodynamic parameters can be measured during a HD session. So far, there is no data regarding the prognostic significance of these parameters.

Methods:

We conducted a prospective cross-sectional study in 185 stable HD patients and measured cardiac index (CI), access flow (AF) and central blood volume index (CBVI) using the Transonic HD03 monitor at the beginning and end of a single HD session. In addition, we calculated systemic CI ($SCI=CI-AF$) and oxygen delivery index ($DO2I=SCI*\text{hemoglobin}*1.34$). Survival analysis was performed after a median follow-up of 606 (interquartile range 593;621).

Results:

During follow-up 33 patients (18%) died. Compared to the survivors, deceased patients tended to have a lower CI ($P=0.09$) and had a significantly reduced SCI and DO2I ($P=0.02$ and 0.002 , resp.). Drop in CI, SCI and DO2I at the end of HD (ΔCI , ΔSCI und $\Delta DO2I$) was significantly higher in deceased patients. In contrast, AF, CVBI and hemoglobin was not different between survivors and deceased patients. Receiver-operator-characteristic (ROC) analysis revealed area-under-the-curve (AUC) values for the endpoint death of 0.68 for DO2I ($P=0.001$) and 0.65 for SCI ($P=0.013$). AUC for ΔCI , ΔSCI and $\Delta DO2I$ ranged between 0.62 and 0.63 ($P=0.02-0.03$). The combination of two parameters such as CI with ΔCI or SCI with ΔSCI or DO2I with $\Delta DO2I$ increased AUC values substantially (0.71-0.75). In addition, cox regression confirmed significant survival benefit at higher DO2I and lower ΔCI , ΔSCI and $\Delta DO2I$.

Conclusion:

This study is the first to show a prognostic significance of hemodynamic parameters in HD patients. Systemic CI and oxygen delivery index at rest as well as drop of these parameters of the end of HD were associated with increased mortality. The results underscore the prognostic relevance of cardiac function for the survival of HD patients.

Hemodynamic Monitoring of Hemodialysis Patients and Predictors of Drop In Cardiac Index During Hemodialysis

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INTRODUCTION AND AIMS:

To investigate the changes in cardiac index (CI) and access flow (AF) during hemodialysis using ultrasound dilution technique in a large patient cohort and to correlate the changes with clinical Parameters.

METHODS:

In cross-sectional study we measured cardiac output (CO), cardiac index (CI) and access flow (AF) at start and end of hemodialysis (HD) in a large cohort (n=185) of stable HD patients using the Transonic HD03 monitor. Data was correlated with clinical parameters and bioimpedance spectroscopy (BCM, Fresenius).

RESULTS:

Median CO and CI at the beginning of HD were 5.2 l/min (interquartile range 4.5;6.4) and 2.8 l/min/m² resp. (2.4;3.3). Access flow (AF) was 980ml/min (740;1385), 20% (14.5;27) of CO (AF/CO). A critical value $\geq 30\%$ was found in 30 persons (16%). CI correlated with AF ($r=0.52$; $p<0.0001$) and inversely with peripheral resistance ($r=-0.75$; $p<0.0001$). At the end of HD, CO and CI dropped to 4.8 l/min (4.1;5.8; $p<0.0001$) and 2.6 l/min/m² (2.2;3.0; $p<0.0001$), resp., while AF remained unchanged (990ml/min [720;1360], $p=0.13$). As peripheral resistance did not change ($p=0.07$), systolic blood pressure dropped from 134/66 to 126/62 mmHg ($p<0.0001$). For 27 % of the patients CI fell by more than 20 % and was associated with a median drop in systolic blood pressure of -6 mmHg (-21;2). CI drop was only weakly correlated with the fall in systolic blood pressure ($r=0.16$; $p=0.0296$). Independent predictors of CI drop were old age ($p=0.0013$) and high UF ($p<0.0001$). An initial overhydration ($p=0.0014$) and increase in peripheral resistance ($p<0.0001$) were found to protect against a drop in CI.

CONCLUSIONS:

Hemodynamic monitoring identified a significant number of patients with increased AF/CO and drops in CI. This raises questions about the therapeutic consequences regarding access flow and circulatory stability.