**Supplemental figure 1: Dilution curve**

Screenshot from the HD03 monitor showing a typical dilution curve after injection of a saline bolus (A). Cardiac output is calculated from the area under the curve shaded in green. Central blood volume (CBV) represents the volume between the injection site and the recording site (including blood in the heart, lungs, and large vessels) and is calculated according to the formula [1]:

,

where *MTTa* is the mean transit time of the indicator through the whole system as recorded by the arterial sensor from the time of injection; *MTTv* is the mean transit time of the indicator as recorded by the venous sensor from the time of injection; *MTTt* is the calculated mean transit time during which the indicator travels in the arterial loop before reaching the sensor [1].

B and C represent the time span (widths) of the venous and arterial curve at one-half the maximum height which is used to calculate total enddiastolic volume (TEDV) according to the formula [1]:

,

where *CO* is cardiac output and *HR* heart rate. TEDV is indexed to body surface area (TEDVI).

Total ejection fraction (TEF, %) was calculated from the stroke volume (SV=CO/HR) and TEDV according to the formula [2]:



**References**

1. Krivitski NM, Kislukhin VV, Thuramalla NV. Theory and in vitro validation of a new extracorporeal arteriovenous loop approach for hemodynamic assessment in pediatric and neonatal intensive care unit patients. Pediatric critical care medicine : a journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies 2008;9(4):423-428

2. Dobson A, Kislukhin VV. Heart blood volume by dilution in patients on hemodialysis. Asaio j 2004;50(3):278-284

**Supplemental table 1: Non-parametric correlations of hemodynamic parameters including overhydration (OH) and NT-pro-BNP.**

Significance level was Bonferroni-adjusted to 0.0014.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | AF | AF/CO | CBVI | SCI | TEDVI | TEF | OH | NT-pro-BNP |
| CI | Correlation coefficient Significance Level P n | **0.416** <0.0001 215 | -0.018 0.7883 215 | **0.349** <0.0001 215 | **0.916** <0.0001 214 | 0.289 0.0084 82 | 0.304 0.0055 82 | 0.182 0.0076 215 | -0.018 0.7972 215 |
| AF | Correlation coefficient Significance Level P n |  | **0.832** <0.0001 215 | -0.026 0.7010 215 | 0.088 0.2001 214 | -0.045 0.6870 82 | 0.210 0.0587 82 | 0.008 0.9103 215 | 0.021 0.7594 215 |
| AF/CO | Correlation coefficient Significance Level P n |  |  | -0.146 0.0320 215 | **-0.363** <0.0001 214 | -0.146 0.1907 82 | 0.034 0.7644 82 | -0.034 0.6177 215 | 0.073 0.2897 215 |
| CBVI | Correlation coefficient Significance Level P n |  |  |  | **0.379** <0.0001 214 | **0.742** <0.0001 82 | **-0.425** 0.0001 82 | **0.438** <0.0001 215 | **0.371** <0.0001 215 |
| SCI | Correlation coefficient Significance Level P n |  |  |  |  | 0.288 0.0087 82 | 0.233 0.0351 82 | 0.185 0.0066 214 | -0.054 0.4322 214 |
| TEDVI | Correlation coefficient Significance Level P n |  |  |  |  |  | **-0.489** <0.0001 82 | **0.433** <0.0001 82 | **0.368** 0.0007 82 |
| TEF | Correlation coefficient Significance Level P n |  |  |  |  |  |  | -0.078 0.4843 82 | **-0.478** <0.0001 82 |
| OH | Correlation coefficient Significance Level P n |  |  |  |  |  |  |  | **0.419** <0.0001 215 |

**Supplemental table 2: Non-parametric correlations of the changes of hemodynamic parameters during HD.**

Significance level was Bonferroni-adjusted to 0.0010.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | ΔCI | ΔAF | ΔAF/CO | ΔSCI | ΔCBVI | ΔPR | Δsys.BP | ΔHR | ΔTEDVI | ΔTEF |
| ΔCI | Correlation coefficient Significance Level P n |  | **0.341** <0.0001 215 | **-0.645** <0.0001 215 | **0.944** <0.0001 213 | **0.678** <0.0001 213 | **-0.760** <0.0001 213 | 0.135 0.0473 215 | -0.048 0.4815 215 | **0.515** <0.0001 79 | 0.344 0.0019 79 |
| ΔAF | Correlation coefficient Significance Level P n |  |  | **0.303** <0.0001 215 | 0.177 0.0097 213 | 0.192 0.0050 213 | -0.120 0.0804 213 | **0.242** 0.0003 215 | -0.083 0.2228 215 | 0.170 0.1335 79 | 0.200 0.0779 79 |
| ΔAF/CO | Correlation coefficient Significance Level P n |  |  |  | **-0.787** <0.0001 213 | **-0.501** <0.0001 213 | **0.641** <0.0001 213 | -0.012 0.8655 215 | 0.050 0.4682 215 | -0.422 0.0001 79 | -0.214 0.0585 79 |
| ΔSCI | Correlation coefficient Significance Level P n |  |  |  |  | **0.683** <0.0001 213 | **-0.782** <0.0001 213 | 0.117 0.0881 213 | -0.024 0.7301 213 | **0.513** <0.0001 79 | 0.343 0.0020 79 |
| ΔCBVI | Correlation coefficient Significance Level P n |  |  |  |  |  | **-0.624** <0.0001 213 | -0.050 0.4697 213 | -0.170 0.0130 213 | **0.550** <0.0001 79 | 0.219 0.0523 79 |
| ΔPR | Correlation coefficient Significance Level P n |  |  |  |  |  |  | **0.301** <0.0001 213 | 0.006 0.9347 213 | **-0.366** 0.0009 79 | -0.290 0.0094 79 |
| Δsys.BP | Correlation coefficient Significance Level P n |  |  |  |  |  |  |  | -0.009 0.8944 215 | 0.204 0.0713 79 | 0.019 0.8669 79 |
| ΔHR | Correlation coefficient Significance Level P n |  |  |  |  |  |  |  |  | -0.246 0.0288 79 | **-0.432** 0.0001 79 |
| ΔTEDVI | Correlation coefficient Significance Level P n |  |  |  |  |  |  |  |  |  | -0.195 0.0850 79 |

**Supplemental table 3. Comparison of hemodynamic parameters between survivors and deceased patients.**

Non-parametric two-sample test. Significance level was Bonferroni-adjusted to 0.0028.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| parameter | survivors | | | deceased | | |  |
| n | median | 95% CI | n | median | 95% CI | P |
| CI, L/min/m², begin | 150 | 2.855 | 2.43 - 3.42 | 65 | 2.67 | 2.35 - 3.98 | 0.0990 |
| CI, L/min/m², end | 150 | 2.59 | 2.22 - 2.98 | 65 | 2.43 | 1.95 - 2.96 | 0.1071 |
| ΔCI, % | 150 | -9.9 | -23.1 - 2.9 | 65 | -10.8 | -20.3 - 3.2 | 0.8189 |
| AF, L/min, begin | 150 | 1.0 | 0.74 - 1.42 | 65 | 0.95 | 0.74 - 1.43 | 0.5797 |
| AF, L/min, end | 150 | 0.99 | 0.73 - 1.36 | 65 | 0.98 | 0.68 - 1.32 | 0.6995 |
| AF/CO, %, begin | 150 | 20 | 14 - 26 | 65 | 21 | 15 - 27 | 0.4349 |
| AF/CO, %, end | 150 | 21 | 14 - 28 | 65 | 21 | 17 - 29 | 0.5118 |
| CBVI, mL/kg. begin | 149 | 14.7 | 11.7 – 17.4 | 65 | 16.2 | 13.2 – 19.1 | 0.0334 |
| CBVI, mL/kg, end | 148 | 13.0 | 9.500 – 16.1 | 65 | 14.4 | 11.8 to 17.2 | 0.0514 |
| SCI, L/min/m², begin | 150 | 2.30 | 2.00 - 2.73 | 65 | 2.00 | 1.70 - 2.60 | 0.0226 |
| SCI, L/min/m², end | 149 | 2.05 | 1.70 - 2.50 | 65 | 1.90 | 1.50 - 2.30 | 0.0597 |
| TEDVI, mL/kg, begin | 47 | 7.41 | 6.01 - 9.04 | 35 | 9.35 | 7.60 - 10.65 | **0.0007** |
| TEDVI, mL/kg, end | 47 | 6.45 | 5.40 - 8.30 | 33 | 8.73 | 6.88 - 9.87 | **0.0026** |
| TEF, %, begin | 47 | 58 | 45 - 66 | 35 | 41 | 35 - 49 | **<0.0001** |
| TEF, %, end | 47 | 56 | 43 - 67 | 33 | 44 | 34 - 50 | **0.0005** |
| NT-pro-BNP, pg/mL | 150 | 3507 | 1473 - 10814 | 65 | 8906 | 4423 - 16838 | **0.0001** |
| OH, L/m² | 150 | 0.8 | 0.3 - 1.4 | 65 | 1.3 | 0.7 - 1.7 | **0.0009** |

OH overhydration from BCM

**Supplementary table 4. C-statistics of the prognostically relevant parameters for cardiovascular mortality.**

Cardiovascular (CV) mortality occurred in n=25 (12%) of the patients, respectively. TEDVI and TEF was analysed in a subgroup with cardiovascular (CV) mortality occurring in n=14 of the patients.

Only values from the begin of HD were analyzed.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| parameter | AUC | 95% CI | p | cut-off | Sens-  itivity | Speci-  ficity |
| SCI, L/min/m² | 0.603 | 0.527-0.677 | 0.1093 | <2.0 | 60% | 67% |
| CBVI, mL/kg | 0.606 | 0.529-0.679 | 0.0577 | >14.6 | 84% | 40% |
| TEDVI, mL/kg | 0.784 | 0.660-0.879 | 0.0001 | >9.5 | 64% | 85% |
| TEF, % | 0.828 | 0.710-0.913 | <0.0001 | <41 | 71% | 85% |
| OH, L/m² | 0.695 | 0.621-0.762 | 0.0002 | >2.4 | 68% | 71% |
| NT-pro-BNP, pg/mL | 0.705 | 0.632-0.772 | 0.0001 | >6504 | 80% | 60% |

**Supplemental table 5. Hazard ratios (and 95% CIs) for cardiovascular mortality from cox regression.**

Cardiovascular mortality occurred in n=25 of the patients, n=150 alive patients were censored. N=40 patients who died from non-cardivascular causes were excluded from the model.

The hazard ratios are displayed for an increase by one standard deviation (SD) of the parameters.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | crude | | adjusted1 | |
| parameter | SD | HR with 95% CI | p | HR with 95% CI | p |
| SCI, L/min/m² | 0.70 | 0.72 (0.44;1.17) | 0.1843 | 0.87 (0.51;1.48) | 0.6035 |
| CBVI, mL/kg | 6.29 | 1.21 (0.80.1.81) | 0.3646 | 0.98 (0.60;1.59) | 0.9219 |
| TEDVI, mL/kg | 2.54 | 1.90 (1.23;2.94) | 0.0040 | 3.14 (1.57;6.29) | 0.0012 |
| TEF, % | 14.86 | 0.33 (0.17;0.60) | 0.0014 | 0.45 (0.20;1.04) | 0.0626 |
| NT-pro-BNP, pg/mL | 14703 | 1.90 (1.45;2.48) | <0.0001 | 2.05 (1.47;2.86) | <0.0001 |
| OH, L/m² | 0.87 | 1.70 (1.20;2.41) | 0.0030 | 2.15 (1.28; 3.61) | 0.0036 |