**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]:

$CBV=CO∙(MTT\_{a}-MTT\_{v}-MTT\_{t})$,

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]:

$TEDV=CO∙\frac{1.62}{HR}+0.77\sqrt{B^{2}-C^{2}}$,

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]:

$$TEF=100 ∙\frac{4∙SV}{TEDV}$$



**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 coefficientSignificance Level Pn | **0.416**<0.0001215 | -0.0180.7883215 | **0.349**<0.0001215 | **0.916**<0.0001214 | 0.2890.008482 | 0.3040.005582 | 0.1820.0076215 | -0.0180.7972215 |
| AF | Correlation coefficientSignificance Level Pn |    | **0.832**<0.0001215 | -0.0260.7010215 | 0.0880.2001214 | -0.0450.687082 | 0.2100.058782 | 0.0080.9103215 | 0.0210.7594215 |
| AF/CO | Correlation coefficientSignificance Level Pn |  |    | -0.1460.0320215 | **-0.363**<0.0001214 | -0.1460.190782 | 0.0340.764482 | -0.0340.6177215 | 0.0730.2897215 |
| CBVI | Correlation coefficientSignificance Level Pn |  |  |    | **0.379**<0.0001214 | **0.742**<0.000182 | **-0.425**0.000182 | **0.438**<0.0001215 | **0.371**<0.0001215 |
| SCI | Correlation coefficientSignificance Level Pn |  |  |  |    | 0.2880.008782 | 0.2330.035182 | 0.1850.0066214 | -0.0540.4322214 |
| TEDVI | Correlation coefficientSignificance Level Pn |  |  |  |  |    | **-0.489**<0.000182 | **0.433**<0.000182 | **0.368**0.000782 |
| TEF | Correlation coefficientSignificance Level Pn |  |  |  |  |  |    | -0.0780.484382 | **-0.478**<0.000182 |
| OH | Correlation coefficientSignificance Level Pn |  |  |  |  |  |  |    | **0.419**<0.0001215 |

**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 coefficientSignificance Level Pn |    | **0.341**<0.0001215 | **-0.645**<0.0001215 | **0.944**<0.0001213 | **0.678**<0.0001213 | **-0.760**<0.0001213 | 0.1350.0473215 | -0.0480.4815215 | **0.515**<0.000179 | 0.3440.001979 |
| ΔAF | Correlation coefficientSignificance Level Pn |  |  | **0.303**<0.0001215 | 0.1770.0097213 | 0.1920.0050213 | -0.1200.0804213 | **0.242**0.0003215 | -0.0830.2228215 | 0.1700.133579 | 0.2000.077979 |
| ΔAF/CO | Correlation coefficientSignificance Level Pn |  |  |    | **-0.787**<0.0001213 | **-0.501**<0.0001213 | **0.641**<0.0001213 | -0.0120.8655215 | 0.0500.4682215 | -0.4220.000179 | -0.2140.058579 |
| ΔSCI | Correlation coefficientSignificance Level Pn |  |  |  |  | **0.683**<0.0001213 | **-0.782**<0.0001213 | 0.1170.0881213 | -0.0240.7301213 | **0.513**<0.000179 | 0.3430.002079 |
| ΔCBVI | Correlation coefficientSignificance Level Pn |  |  |  |  |    | **-0.624**<0.0001213 | -0.0500.4697213 | -0.1700.0130213 | **0.550**<0.000179 | 0.2190.052379 |
| ΔPR | Correlation coefficientSignificance Level Pn |  |  |  |  |  |  | **0.301**<0.0001213 | 0.0060.9347213 | **-0.366**0.000979 | -0.2900.009479 |
| Δsys.BP | Correlation coefficientSignificance Level Pn |  |  |  |  |  |  |    | -0.0090.8944215 | 0.2040.071379 | 0.0190.866979 |
| ΔHR | Correlation coefficientSignificance Level Pn |  |  |  |  |  |  |  |  | -0.2460.028879 | **-0.432**0.000179 |
| ΔTEDVI | Correlation coefficientSignificance Level Pn |  |  |  |  |  |  |  |  |    | -0.1950.085079 |

**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 |