 Fig. S1. Schematic of the study protocol. ICU, intensive care unit; ABG, arterial blood gas; cVBG, central venous blood gas.

Table S1. Arterial and central venous blood gas values.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | ABG  (Mean ± SD) | cVBG  (Mean ± SD) | A-V difference  (Mean ± SD) | 95% LOA |
| All samples (n = 292) | | | | |
| pH | 7.44 ± 0.07 | 7.40 ± 0.07 | 0.05 ± 0.05 | −0.05 to 0.15 |
| pCO2 (mmHg) | 37.03 ± 8.28 | 42.68 ± 8.79 | −5.56 ± 4.97 | −15.30 to 4.19 |
| Base excess (mmEq/L) | 0.97 ± 4.53 | 0.60 ± 4.99 | 0.37 ± 2.41 | −4.36 to 5.10 |
| HCO3 (mmEq/L) | 25.46 ± 3.93 | 24.56 ± 4.23 | 0.91 ± 1.94 | −2.90 to 4.71 |
| Lactic acid (mmol/L)\* | 2.35 ± 2.34 | 2.07 ± 1.92 | −0.02 ± 0.34 | −0.69 to 0.66 |

\*The numbers of lactic acid samples in ABG, VBG, and A-V difference were 165, 215, and 139, respectively.

ABG, arterial blood gas; A-V = arterial blood gas to venous blood gas; LOA, limits of agreements; cVBG, central venous blood gas; SD, standard deviation

Table S2. Baseline characteristics between subjects with ΔpCO2 > 6 and ΔpCO2 ≤ 6.

|  |  |  |
| --- | --- | --- |
| Characteristics | ΔpCO2 > 6 (n = 133) | ΔpCO2 ≤ 6 (n = 159) |
| Age, median (IQR) | 68.0 (60.0–78.0) | 65.0 (59.0–70.0) |
| Sex, n (%) | | |
| Male | 96 (72.2) | 132 (83.0) |
| Female | 37 (27.8) | 27 (17.0) |
| Primary diagnosis, n (%) | | |
| Infection | 93 (69.9) | 125 (78.6) |
| Hemorrhagic hypovolemia | 2 (1.5) | 1 (0.6) |
| Cardiac abnormality | 9 (6.8) | 6 (3.8) |
| Respiratory abnormality | 17 (12.8) | 15 (9.4) |
| Other\* | 12 (9.0) | 12 (7.5) |
| Preexisting condition, n (%) | | |
| Heart failure | 12 (9.0) | 15 (9.4) |
| Liver cirrhosis | 11 (8.3) | 18 (11.3) |
| Chronic renal failure | 15 (11.3) | 14 (8.8) |
| Time interval between ABG and VBG, minutes (IQR) | 3.0 (1.0–5.0) | 3.0 (1.0–5.0) |
| Shock (mean arterial pressure < 65 mmHg), n (%) | 10 (7.5) | 8 (5.0) |
| Organ support at the time of blood sampling, n (%) | | |
| Mechanical ventilation\*\* | 90 (67.7) | 124 (78.0) |
| Renal replacement therapy | 32 (24.1) | 43 (27.0) |
| Vasopressor requirement | 52 (39.1) | 55 (34.6) |

\*Others included pancreatitis, hepatic failure, acute kidney injury, thrombotic thrombocytopenic purpura, and hyperosmolar hyperglycemic state

\*\**P* = 0.047

ΔpCO2, difference of arterial pCO2 and venous pCO2; ABG, arterial blood gas; IQR, interquartile range; VBG, venous blood gas

Table S3. Intraclass correlations for pCO2 in the arterial and central venous blood samples of subjects who contributed more than two samples.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Patient | No. of samples | ICC | 95% CI | | *P*-value | |
| 1 | 4 | 0.451 | −1.327 to 0.957 | 0.263 | |
| 4 | 3 | 0.673 | −2.077 to 0.991 | 0.210 | |
| 5 | 4 | 0.349 | −0.079 to 0.909 | 0.065 | |
| 6 | 4 | 0.639 | −0.089 to 0.969 | 0.019 | |
| 8 | 4 | 0.511 | −0.125 to 0.950 | 0.056 | |
| 10 | 5 | 0.535 | −0.095 to 0.932 | 0.017 | |
| 11 | 5 | 0.594 | −0.047 to 0.946 | 0.003 | |
| 12 | 8 | 0.073 | −0.133 to 0.514 | 0.314 | |
| 13 | 7 | 0.610 | −0.052 to 0.916 | 0.028 | |
| 15 | 2 | −0.211 | −0.236 to -0.232 | 0.818 | |
| 16 | 3 | 0.198 | −0.166 to 0.941 | 0.286 | |
| 17 | 4 | 0.566 | −0.146 to 0.959 | 0.056 | |
| 18 | 5 | −0.120 | −0.377 to 0.612 | 0.676 | |
| 20 | 3 | 0.360 | −0.128 to 0.964 | 0.159 | |
| 21 | 5 | 0.319 | −0.043 to 0.853 | 0.018 | |
| 22 | 5 | 0.236 | −0.133 to 0.815 | 0.152 | |
| 25 | 3 | −0.460 | Not measurable | 0.984 | |
| 26 | 3 | 0.115 | −0.348 to 0.940 | 0.406 | |
| 27 | 2 | 0.307 | 0.000 to 0.997 | 0.020 | |
| 28 | 3 | 0.424 | −0.129 to 0.971 | 0.133 | |
| 29 | 7 | 0.663 | −0.104 to 0.938 | 0.003 | |
| 30 | 4 | 0.499 | −0.079 to 0.947 | 0.032 | |
| 32 | 4 | 0.604 | −0.123 to 0.964 | 0.037 | |
| 33 | 6 | 0.791 | 0.190 to 0.967 | 0.016 | |
| 34 | 3 | 0.124 | −0.159 to 0.920 | 0.343 | |
| 35 | 2 | 0.102 | −0.005 to 0.988 | 0.135 | |
| 36 | 5 | 0.504 | −0.137 to 0.924 | 0.041 | |
| 37 | 4 | 0.308 | −0.050 to 0.891 | 0.048 | |
| 38 | 3 | 0.672 | −0.125 to 0.988 | 0.061 | |
| 39 | 5 | 0.072 | −0.207 to 0.714 | 0.384 | |
| 40 | 2 | 0.347 | −0.094 to 0.998 | 0.235 | |
| 42 | 6 | 0.442 | −0.184 to 0.883 | 0.089 | |
| 43 | 4 | 0.068 | −0.157 to 0.769 | 0.382 | |
| 44 | 6 | 0.669 | −0.110 to 0.947 | 0.008 | |
| 45 | 7 | 0.417 | −0.089 to 0.856 | 0.010 | |
| 46 | 3 | 0.663 | −0.072 to 0.988 | 0.037 | |
| 47 | 5 | 0.133 | −0.562 to 0.836 | 0.388 | |
| 48 | 5 | 0.660 | −0.014 to 0.959 | < 0.001 | |
| 49 | 8 | 0.865 | −0.038 to 0.979 | < 0.001 | |
| 50 | 7 | 0.549 | −0.127 to 0.903 | 0.015 | |
| 51 | 4 | 0.670 | −0.108 to 0.972 | 0.022 | |
| 52 | 6 | 0.482 | −0.283 to 0.902 | 0.122 | |
| 53 | 2 | 0.696 | −0.244 to 0.999 | 0.191 | |
| 55 | 2 | 0.855 | −0.049 to 1.000 | 0.068 | |
| 56 | 3 | 0.211 | −0.088 to 0.933 | 0.203 | |
| 57 | 5 | 0.265 | −0.112 to 0.829 | 0.106 | |
| 58 | 3 | 0.148 | −0.243 to 0.938 | 0.359 | |
| 59 | 2 | −0.043 | −0.046 to -0.046 | 0.825 | |
| 60 | 2 | 0.483 | −0.064 to 0.999 | 0.160 | |
| 63 | 4 | 0.488 | −0.188 to 0.948 | 0.104 | |
| 64 | 2 | 0.006 | −0.109 to 0.986 | 0.491 | |
| 65 | 3 | 0.189 | −0.064 to 0.921 | 0.182 | |
| 66 | 2 | 0.397 | 0.000 to 0.998 | 0.029 | |
| 67 | 2 | 0.196 | −0.049 to 0.995 | 0.248 | |
| 68 | 3 | 0.573 | −0.073 to 0.982 | 0.052 | |
| 69 | 7 | 0.082 | −0.053 to 0.481 | 0.149 | |
| 70 | 2 | 0.713 | −0.004 to 0.999 | 0.036 | |
| 71 | 2 | 0.000 | −0.618 to 0.996 | 0.500 | |
| 72 | 4 | 0.668 | −0.234 to 0.973 | 0.094 | |
| 73 | 5 | 0.872 | 0.326 to 0.985 | 0.012 | |
| 74 | 5 | 0.084 | −0.078 to 0.625 | 0.256 | |
| 75 | 6 | 0.337 | −0.097 to 0.834 | 0.038 | |
| 76 | 5 | 0.686 | −0.076 to 0.960 | 0.043 | |
| 77 | 5 | 0.130 | −0.052 to 0.677 | 0.117 | |
| 79 | 3 | −0.023 | −0.243 to 0.869 | 0.530 | |
| 80 | 3 | 0.621 | −0.184 to 0.986 | 0.102 | |
| 81 | 6 | 0.632 | −0.057 to 0.943 | 0.001 | |
| 82 | 4 | 0.624 | −0.192 to 0.968 | 0.082 | |

ICC, intraclass coefficient; CI, confidence interval

Table S4. Comparison of intraclass correlations for pH, pCO2, base excess, HCO3, and lactic acid in arterial and central venous blood samples across other subgroups.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameters | Coefficient\* | 95% CI | Coefficient\* | 95% CI | *P*-value |
| Shock | (−) (n = 274) | | (+) (n = 18) | |  |
| pH | 0.625 | 0.081 to 0.823 | 0.627 | 0.030 to 0.866 | 0.495 |
| pCO2 (mmHg) | 0.701 | 0.021 to 0.883 | 0.649 | −0.023 to 0.884 | 0.359 |
| Base excess (mmEq/L) | 0.866 | 0.832 to 0.893 | 0.904 | 0.764 to 0.963 | 0.253 |
| HCO3 (mmEq/L) | 0.861 | 0.769 to 0.910 | 0.912 | 0.757 to 0.968 | 0.181 |
| Lactic acid (mmol/L)† | 0.989 | 0.985 to 0.992 | 0.982 | 0.791 to 0.999 | 0.402 |
| Vasopressor or shock | (−) (n = 181) | | (+) (n = 111) | |  |
| pH | 0.502 | 0.075 to 0.721 | 0.748 | 0.003 to 0.912 | <0.0001 |
| pCO2 (mmHg) | 0.742 | 0.040 to 0.904 | 0.610 | −0.014 to 0.834 | 0.022 |
| Base excess (mmEq/L) | 0.787 | 0.723 to 0.837 | 0.948 | 0.925 to 0.964 | <0.0001 |
| HCO3 (mmEq/L) | 0.797 | 0.670 to 0.868 | 0.936 | 0.870 to 0.964 | <0.0001 |
| Lactic acid (mmol/L)† | 0.972 | 0.957 to 0.982 | 0.990 | 0.983 to 0.994 | 0.002 |
| Vasopressor in ventilated subjects | (−) (n = 123) | | (+) (n = 91) | |  |
| pH | 0.656 | −0.022 to 0.865 | 0.771 | −0.018 to 0.926 | 0.046 |
| pCO2 (mmHg) | 0.788 | 0.152 to 0.921 | 0.650 | −0.014 to 0.861 | 0.019 |
| Base excess (mmEq/L) | 0.869 | 0.817 to 0.906 | 0.949 | 0.924 to 0.966 | <0.0001 |
| HCO3 (mmEq/L) | 0.846 | 0.712 to 0.909 | 0.938 | 0.863 to 0.967 | <0.0001 |
| Lactic acid (mmol/L)† | 0.965 | 0.940 to 0.979 | 0.991 | 0.983 to 0.995 | 0.001 |
| Controlled ventilation | (−) (n = 56) | | (+) (n = 158) | |  |
| pH | 0.453 | −0.097 to 0.757 | 0.787 | 0.041 to 0.927 | <0.001 |
| pCO2 (mmHg) | 0.726 | 0.122 to 0.893 | 0.739 | 0.053 to 0.902 | 0.430 |
| Base excess (mmEq/L) | 0.851 | 0.757 to 0.911 | 0.937 | 0.914 to 0.953 | 0.002 |
| HCO3 (mmEq/L) | 0.822 | 0.611 to 0.910 | 0.923 | 0.852 to 0.955 | 0.003 |
| Lactic acid (mmol/L)† | 0.965 | 0.909 to 0.987 | 0.990 | 0.984 to 0.993 | 0.012 |

\*The *P-*values of all parameters were lower than 0.05.

CI, confidence interval

†The samples included in the analysis of lactic acid were as follows: 135 and 4 for shock, 84 and 55 for vasopressor or shock, 54 and 45 for vasopressor in ventilated subjects, and 18 and 81 for controlled ventilation.

Table S5. Intraclass coefficients for pH, pCO2, base excess, HCO3, and lactic acid in the arterial and central venous blood samples of the adjusted models.

|  |  |  |  |
| --- | --- | --- | --- |
| Parameters | Agreement coefficient | 95% CI | *P*-value |
| Adjusted model (all samples, n = 292) | | | |
| pH | 0.744 | 0.642 to 0.813 | <0.0001 |
| pCO2 (mmHg) | 0.833 | 0.767 to 0.877 | <0.0001 |
| Adjusted model 1 (mechanically ventilated subjects with ScvO2 ≥ 70%, n = 133) | | | |
| pH | 0.871 | 0.822 to 0.907 | <0.0001 |
| pCO2 (mmHg) | 0.918 | 0.886 to 0.941 | <0.0001 |
| Adjusted model 2 (mechanically ventilated subjects with ScvO2 ≥ 70% without RRT, n = 104) | | | |
| pH | 0.892 | 0.844 to 0.925 | <0.0001 |
| pCO2 (mmHg) | 0.925 | 0.892 to 0.949 | <0.0001 |
| Adjusted model 3 (mechanically ventilated subjects with ScvO2 ≥ 70% without vasopressors, n = 84) | | | |
| pH | 0.850 | 0.778 to 0.900 | <0.0001 |
| pCO2 (mmHg) | 0.924 | 0.885 to 0.950 | <0.0001 |

CI, confidence interval; ScvO2, central venous O2 saturation; RRT, renal replacement therapy