RSPT 1050 - Module G: Oxygen Transport

XIII. Equations

Given the following, calculate the CaO_2, CvO_2 and the Ca-vDO_2:

A. Hb: 6 gm% SaO_2: 84% PaO_2: 80 mm Hg SvO_2: 66% PvO_2: 43 mm Hg
CaO_2: (Hb x 1.34 x SaO_2) + (PaO_2 x .003) = (6 x 1.34 x .84)+(80 x .003) = 6.75 + .24 = 7.0 vol%
CvO_2: (Hb x 1.34 x SvO_2) + (PvO_2 x .003) = (6 x 1.34 x .66)+(43 x .003) = 5.31 + .13 = 5.4 vol%
$C_{(a-v)}O_2$: CaO_2 – CvO_2 = 7.0 – 5.4 = 1.6 vol%

B. Hb: 12 gm% SaO_2: 67% PaO_2: 55 mm Hg SvO_2: 45% PvO_2: 35 mm Hg
CaO_2: (Hb x 1.34 x SaO_2) + (PaO_2 x .003) = (12 x 1.34 x .67)+(55 x .003) = 10.77 + .17 = 10.9 vol%
CvO_2: (Hb x 1.34 x SvO_2) + (PvO_2 x .003) = (12 x 1.34 x .45)+(35 x .003) = 7.24 + .11 = 7.4 vol%
$C_{(a-v)}O_2$: CaO_2 – CvO_2 = 10.9 – 7.4 = 3.5 vol%

C. Hb: 14.5 gm% SaO_2: 88% PaO_2: 78 mm Hg SvO_2: 70% PvO_2: 40 mm Hg
CaO_2: (Hb x 1.34 x SaO_2) + (PaO_2 x .003) = (14.5 x 1.34 x .88) + (78 x .003) = 17.10 + .23 = 17.3 vol%
CvO_2: (Hb x 1.34 x SvO_2) + (PvO_2 x .003) = (14.5 x 1.34 x .7) + (40 x. 003) = 13.60 + .12 = 13.7 vol%
$C_{(a-v)}O_2$: CaO_2 – CvO_2 = 17.3 – 13.7 = 3.6 vol%

D. Hb: 8.8 gm% SaO_2: 75% PaO_2: 40 mm Hg SvO_2: 66% PvO_2: 35 mm Hg
CaO_2: (Hb x 1.34 x SaO_2) + (PaO_2 x .003) = (8.8 x 1.34 x .75) + (40 x .003) = 8.84 + .12 = 9.0 vol%
CvO_2: (Hb x 1.34 x SvO_2) + (PvO_2 x .003) = (8.8 x 1.34 x .66) + (35 x .003) = 7.78 + .11 = 7.9 vol%
$C_{(a-v)}O_2$: CaO_2 – CvO_2 = 9.0 – 7.9 = 1.1 vol%

E. Hb: 10 gm% SaO_2: 78% PaO_2: 55 mm Hg SvO_2: 69% PvO_2: 36 mm Hg
CaO_2: (Hb x 1.34 x SaO_2) + (PaO_2 x .003) = (10 x 1.34 x .78) + (55 x .003) = 10.45 + .17 = 10.6 vol%
CvO_2: (Hb x 1.34 x SvO_2) + (PvO_2 x .003) = (10 x 1.34 x .69) + (36 x .003) = 9.25 + .11 = 9.4 vol%
$C_{(a-v)}O_2$: CaO_2 – CvO_2 = 10.6 – 9.4 = 1.2 vol%

ITEMS F THROUGH J ARE IMPOSSIBLE. PaO_2 CAN NEVER BE LESS THAN PvO_2.
TRY DOING THE PROBLEMS WITH THE PaO_2 & SaO_2 REVERSED WITH THE VENOUS VALUES

F. Hb: 10 gm% SvO_2: 75% PvO_2: 40 mm Hg SaO_2: 87% PaO_2: 77 mm Hg

CaO_2: (Hb x 1.34 x SaO_2) + (PaO_2 x .003) = (10 x 1.34 x .87) + (77 x .003) = 11.66 + .23 = 11.9 vol%

CvO_2: (Hb x 1.34 x SvO_2) + (PvO_2 x .003) = (10 x 1.34 x .75) + (40 x .003) = 10.05 + .12 = 10.2 vol%

$C_{(a-v)}O_2$: CaO_2 – CvO_2 = 11.9 – 10.2 = 1.7 vol%

G. Hb: 12 gm% SvO_2: 66% PvO_2: 44 mm Hg SaO_2: 93% PaO_2: 89 mm Hg

CaO_2: (Hb x 1.34 x SaO_2) + (PaO_2 x .003) = (12 x 1.34 x .93) + (89 x .003) = 14.95 + .27 = 15.2 vol%

CvO_2: (Hb x 1.34 x SvO_2) + (PvO_2 x .003) = (12 x 1.34 x .66) + (44 x .003) = 10.61 + .13 = 10.7 vol%

$C_{(a-v)}O_2$: CaO_2 – CvO_2 = 15.2 – 10.7 = 4.5 vol%

H. Hb: 8.5 gm% SvO_2: 68% PvO_2: 55 mm Hg SaO_2: 95% PaO_2: 83 mm Hg

CaO_2: (Hb x 1.34 x SaO_2) + (PaO_2 x .003) = (8.5 x 1.34 x .95) + (83 x .003) = 10.82 + .25 = 11.1 vol%

CvO_2: (Hb x 1.34 x SvO_2) + (PvO_2 x .003) = (8.5 x 1.34 x .68) + (55 x .003) = 7.75 + .19 = 7.9 vol%

$C_{(a-v)}O_2$: CaO_2 – CvO_2 = 11.1 – 7.9 = 3.2 vol%

I. Hb: 14 gm% SvO_2: 75% PvO_2: 40 mm Hg SaO_2: 79% PaO_2: 60 mm Hg

CaO_2: (Hb x 1.34 x SaO_2) + (PaO_2 x .003) = (14 x 1.34 x .79) + (60 x .003) = 14.82 + .18 = 15.0 vol%

CvO_2: (Hb x 1.34 x SvO_2) + (PvO_2 x .003) = (14 x 1.34 x .75) + (40 x .003) = 14.07 + .12 = 14.2 vol%

$C_{(a-v)}O_2$: CaO_2 – CvO_2 = 15.0 – 14.2 = 0.8 vol%

J. Hb: 18 gm% SvO_2: 78% PvO_2: 50 mm Hg SaO_2: 96% PaO_2: 93 mm Hg

CaO_2: (Hb x 1.34 x SaO_2) + (PaO_2 x .003) = (18 x 1.34 x .96) + (93 x .003) = 23.12 + .28 = 23.4 vol%

CvO_2: (Hb x 1.34 x SvO_2) + (PvO_2 x .003) = (18 x 1.34 x .78) + (50 x .003) = 18.81 + .15 = 19.0 vol%

$C_{(a-v)}O_2$: CaO_2 – CvO_2 = 23.4 - 19.0 = 4.4 vol%

Given the following information, calculate the % shunt

Hb: 13g% P_{baro}: 750 mm Hg PaO_2: 50 mm Hg FiO_2: 70% $PaCO_2$: 43 mm Hg
SaO_2: 85% PvO_2: 37 mm Hg SvO_2: 65%

K. PAO_2 = **$[(P_{baro} - P_{H20}) \times FiO_2) - (PaCO_2 \times 1.25) = [(750-47) \times .7] - (43 \times 1.25) = (703 \times .7) - 53.75 = 492.1 - 53.75 = 438$ mm Hg**

L. CcO_2 = **$(Hb \times 1.34 \times 1.0) + (PAO_2 \times .003) = (13 \times 1.34) + (438 \times .003) = 17.42 + 1.31 = 18.73$ vol%**

M. CaO_2 = **$(Hb \times 1.34 \times SaO_2) + (PaO_2 \times .003) = (13 \times 1.34 \times .85) + (50 \times .003) = 14.81 + 0.15 = 14.96$ vol%**

N. CvO_2 = **$(Hb \times 1.34 \times SvO_2) + (PvO_2 \times .003) = (13 \times 1.34 \times .65) + (37 \times .003) = 11.32 + 0.11 = 11.43$ vol%**

O. $$\frac{Q_s}{Q_t} = \frac{(Cc'O_2 - CaO_2)}{(Cc'O_2 - C\bar{v}O_2)} = \frac{(18.73 - 14.96)}{(18.73 - 11.43)} = \frac{3.77}{7.3} = .516 = 51.6\%$$

Given the following information, calculate the % shunt

Hb: 8g% P_{baro}: 740 mm Hg PaO_2: 67 mm Hg FiO_2: 70% $PaCO_2$: 55 mm Hg
SaO_2: 92% PvO_2: 38 mm Hg SvO_2: 68%

P. PAO_2 = **$[(P_{baro} - P_{H20}) \times FiO_2) - (PaCO_2 \times 1.25) = [(740-47) \times .7] - (55 \times 1.25) = (693 \times .7) - 68.75 = 485.1 - 68.75 = 416$ mm Hg**

Q. CcO_2 = **$(Hb \times 1.34 \times 1.0) + (PAO_2 \times .003) = (8 \times 1.34) + (416 \times .003) = 10.72 + 1.25 = 11.97$ vol%**

R. CaO_2 = **$(Hb \times 1.34 \times SaO_2) + (PaO_2 \times .003) = (8 \times 1.34 \times .92) + (67 \times .003) = 9.86 + .20 = 10.06$ vol%**

S. CvO_2 = **$(Hb \times 1.34 \times SvO_2) + (PvO_2 \times .003) = (8 \times 1.34 \times .68) + (38 \times .003) = 7.29 + 0.11 = 7.4$ vol%**

T. $$\frac{Q_s}{Q_t} = \frac{(Cc'O_2 - CaO_2)}{(Cc'O_2 - C\bar{v}O_2)} = \frac{(11.97 - 10.06)}{(11.97 - 7.4)} = \frac{1.91}{4.57} = .418 = 41.8\%$$