GAS EXCHANGE IN THE TISSUES AND LUNGS

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CBU SCHOOL OF MEDICINE

IN THE TlSSUES

- The PCO2 in the tissues is higher than that in the arterial blood (about 46 and 40 mmHg at rest respectively).

- Therefore, C02 diffuses passively down this gradient from the tissues to the blood, in which it is carried in the plasma and red blood cells as described above and *chloride shift occurs.*

- On the other hand, the P02 in the arterial blood is higher than that in the tissues (about 95 and 40 mmHg at rest respectively).

- Therefore, 02 diffuses passively down this gradient from the arterial blood to the tissues, and oxyHb is changed into reduced Hb.

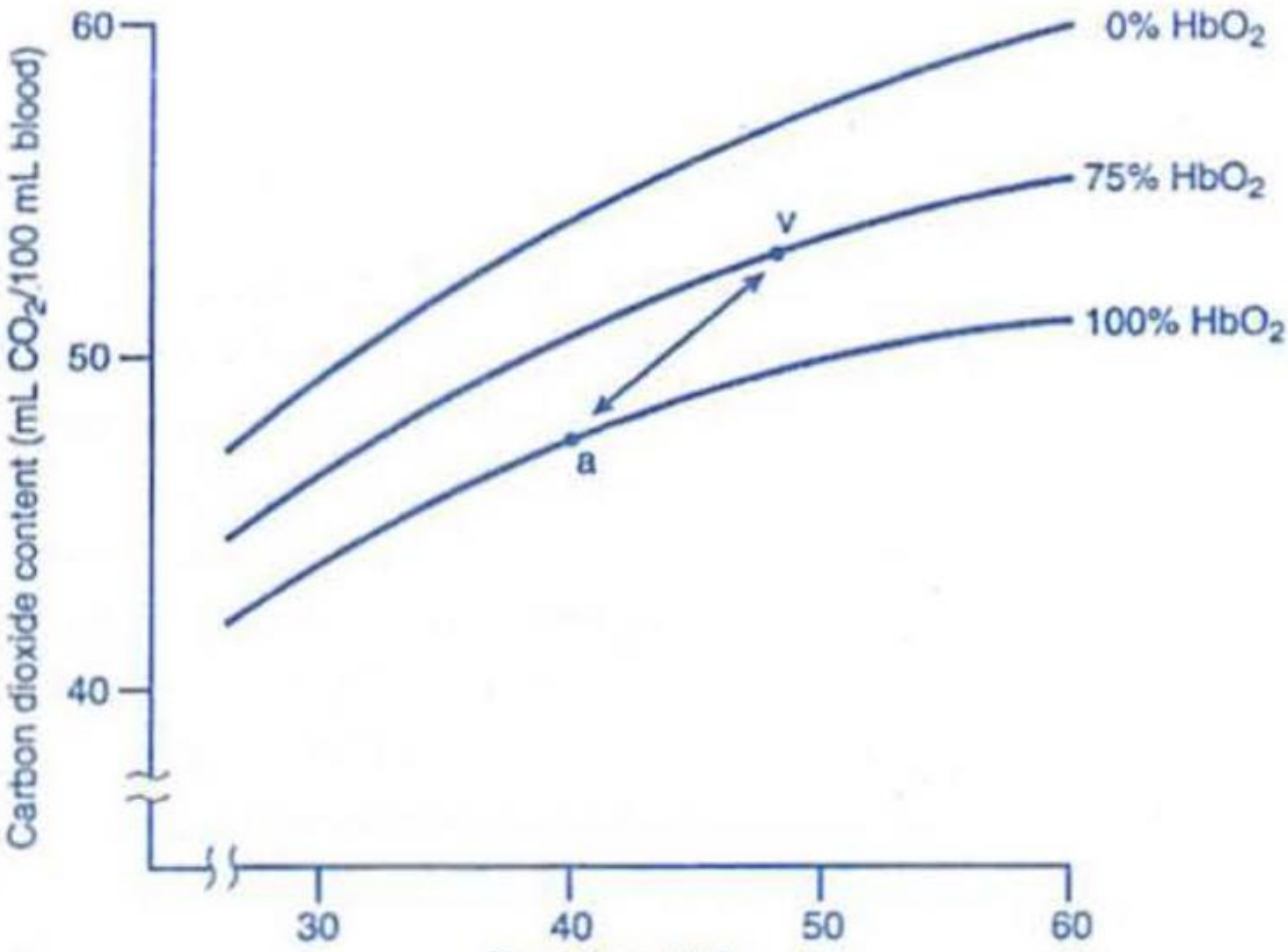
IN THE LUNGS

- The PCO2 in the venous blood is more than that in the alveolar air (about 46 and 40 mmHg at rest respectively).

- Therefore, C02 diffuses passively down this gradient from the venous blood to the alveolar air (to be eliminated in the expired air) and *the chloride shift is reversed*

- On the other hand, the Pen in the alveolar air is higher than that in the venous blood (about I00 and 40 mmHg at rest respectively).

- Therefore, 02 diffuses passively down this gradient from the alveolar air to the blood and combines with Hb, forming oxyHb.



The CO_2 dissociation curves.

THE C02 DISSOCIATION CURVES

- These curves show the relation between the PCO2 level in the blood and the total C02 content /dL. They are more *linear than the O2Hb dissociation curve* and are *constructed in a similar way*

- 3 curves *are usually drawn*, *one for the arterial blood during rest* (in which Hb is about 97 % saturated with 0 2)

- *One for the venous blood during rest* (in which Hb is about 75 % saturated with 0 2) ,

- A third one for *completely reduced (i.e. deoxygenated) blood* (in which Hb is zero % saturated with 02)

SIGNIFICANCE OF THE C02 DISSOCIATION CURVES

1. Study of the physiological C02 dissociation curve

- Point (A) represents the C02 conditions in the *arterial blood at rest* (where the PCO2 is 40 mmHg and the C02 content 49 ml/dL) while point (V) represents the C02 conditions in the *venous blood at rest* (where the Pc02 is 46 mmHg and the C02 content 52.7 ml/dL)

- The line that joins points (A) and (V) is the physiological C02 dissociation curve.

- It represents the changes In PCO2 and C02 content that occur in the systemic blood as it flows from the arteries to the veins during rest, and from its extension upwards predicts the increases in PCO2 & CO2 content in the venous blood that would occur when CO2 production increases in the tissues as a result of increased activity.

2. Study of the Haldane's effect

- Haldane's effect is the *effect of 02 on the CO2 carrying ability of Hb.*

- The presence of the curve of the arterial blood normally below that of the venous blood indicates that at any PCO2, the venous (deoxygenated) blood carries more C02 than does the arterial (oxygenated) blood.

- This is true since *reduced Hb carries more CO2 than oxyHb* as carbHb

❑ Such effect is *physiologically significant* because deoxygenation of oxyHb in the tissues will help carriage of more tidal C02 as carbHb, while oxygenation of reduced Hb in the lungs will help C02 release from Hb and its excretion in the alveolar air then elimination in the expired air.

❑For this reason if *oxyHb is not deoxygenated in the tissues, the addition of the tidal C02 would increase the PC02 to 54 mmHg instead of 46 mmHg* (as shown from the line extending from point V on meeting the curve of the arterial blood).

❑In this case, there is less formation of carbHb (due to the low affinity of oxyHb to C02) and *more physical dissolution of C02* in the blood (which increases the PC02) . The later results in *acidosis,* which is favoured because *oxyHb is also a weak* H+ *acceptor*

*** The exposure of blood to the high PCO2 in the tissues shifts the 02-Hb dissociation curve to the right (= Bohr's effect) i.e. facilitates Hb-02 unloading, and this helps Hb-C02 loading (= Haldane's effect)

Conversely, the exposure of blood to the low PCO2 in the lungs shifts the 02-Hb dissociation curve to the left i.e. facilitates Hb-02 loading, and this helps HbC02 unloading.

Therefore, the loading and unloading of both 02 and C02 are *mutually-helpful (i.e. help each other) in both the lungs and tissues.*