

Title: EFFECT OF TEMPERATURE ON TRANSCUTANEOUS GAS TRANSFER OF HELIUM AND OXYGEN

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The interpretation of transcutaneous pO_2 is often difficult under conditions of hypoperfusion, and low PaO_2 . Most workers using transcutaneous pO_2 probes have found good correlations between PaO_2 and $TcPO_2$ in normal subjects with probe temperatures between 42 and 44°C. Correlations deteriorate under conditions of low probe temperature (less than 42°C) low PaO_2 (less than 70 torr) and poor perfusion.

This study was undertaken to delineate the influence of probe temperature and inspired tension on the transfer of oxygen and helium through the skin. We measured the simultaneous flux of helium and oxygen through the skin in four human subjects breathing mixtures of helium and oxygen. A heated probe was applied to the skin of the forearm of the subject. The study was approved by the Committee for Research in Humans of the University of Pennsylvania. Pure nitrogen was used as a carrier gas through the probe, picking up oxygen and helium as it swept over the skin. The two test gases were measured simultaneously downstream from the probe using a mass spectrometer system. Helium was chosen as a test gas because its diffusion through the skin is virtually perfusion limited.

We studied the effects of probe temperature and inspired concentration on the transcutaneous flux of these two gases.

Results and Discussion:

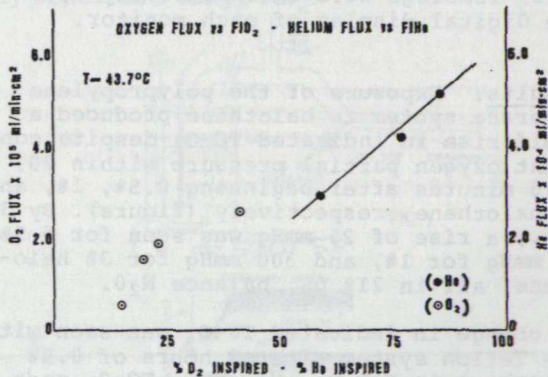
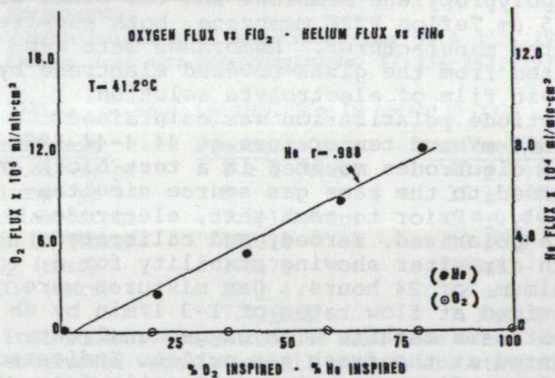
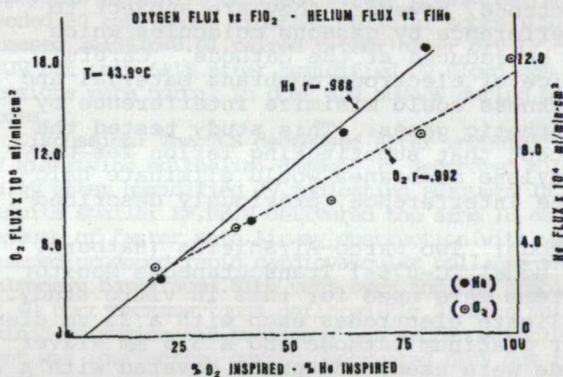
The results are summarized in the illustrations, which are typical plots from individual subjects.

The transcutaneous flux of helium is linearly related to the inspired concentration of helium over the range of $F_{I,He}$ 0.20 to 0.80 (upper plot). The slope of the flux to concentration ratio shows a moderate probe temperature dependence over a probe temperature range of 41°C to 44°C (middle plot).

The transcutaneous flux of oxygen is linearly related to inspired concentration of oxygen over the range of F_{I,O_2} 0.20 to 0.80 providing the probe temperature is at least 42°C (upper plot). However, the slope of the concentration to flux characteristic for oxygen is markedly temperature dependent and no oxygen flux can be detected at probe temperatures less than 42°C (middle plot). In addition, the concentration to flux plot for oxygen shows a non-linearity at F_{I,O_2} 's less than 0.20 (lower plot).

We conclude that probe temperature markedly affects the transfer of oxygen through the skin and that the effects are only partially related to blood flow under

the probe. The temperature effects on oxygen transfer are related to combination of effects, including blood flow, skin permeability and a shifting of the oxygen Hb dissociation curve to the right with increasing temperature.



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