Relationship between retinal blood flow and arterial oxygen

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Retinal blood flow (RBF) Increases in response to a reduction in oxygen (hypoxia) but decreases in response to increased oxygen (hyperoxia). However, the relationship between blood flow and the arterial partial pressure of oxygen has not been quantified and modelled in the retina, particularly in the vascular reserve and resting tonus of the vessels. The present study aimed to determine the limitations of the retinal vasculature by modelling the relationship between RBF and oxygen. Retinal vascular responses were measured in 13 subjects for eight different blood gas conditions, with the end-tidal partial pressure of oxygen (P ETC O2) ranging from 40-500mmHq. Retinal vascular response measurements were repeated twice; using the Canon laser blood flowmeter (Canon Inc., Tokyo, Japan) during the first visit and using Doppler spectral domain optical coherence tomography during the second visit. We determined that the relationship between RBF and PaO2 can be modelled as a combination of hyperbolic and linear functions. We concluded that RBF compensated for decreases in arterial oxygen content for all stages of hypoxia used in the present study but can no longer compensate below a PETC O2 of 32-37mmHg. These vessels have a great vascular range of adjustment, increasing diameter (8.5% arteriolar and 21% total venous area) with hypoxia (40mmHg P ETC O2; P<0.001) and decreasing diameter (6.9% arteriolar and 23% total venous area) with hyperoxia (500mmHig P ETC O2: P<0.001) to the same extent. This indicates that the resting tonus is near the mid-point of the adjustment ranges at resting PaO2 where sensitivity is maximum.

Keywords

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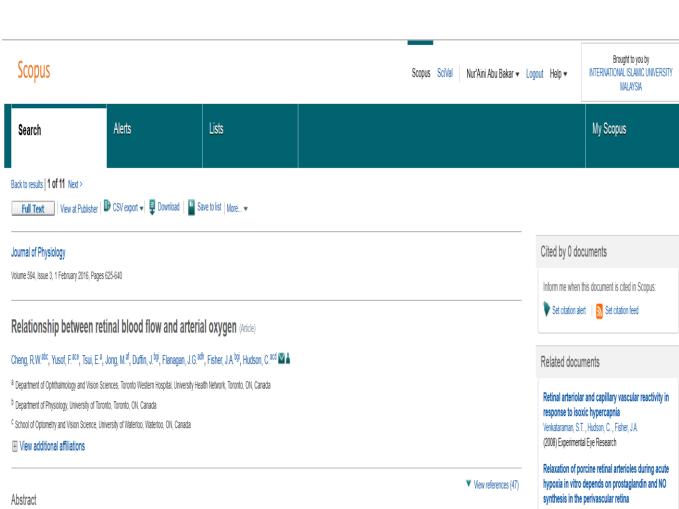
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Key points: Vascular reactivity, the response of the vessels to a vasoactive stimulus such as hypoxia and hyperoxia, can be used to assess the vascular range of adjustment in which the vessels are able to compensate for changes in PO2. Previous studies in the retina have not accurately quantified retinal vascular responses and precisely targeted multiple PaO2 stimuli at the same time as controlling the level of carbon dioxide, thus precluding them from modelling the relationship between retinal blood flow and oxygen. The present study modelled the relationship between retinal blood flow and PaO2, showing them to be a combined linear and hyperbolic function. This model demonstrates that the resting tonus of the vessels is at the mid-point and that they have great vascular range of adjustment, compensating for decreases in oxygen above a P ETC O2 of 32-37 mmHg but being limited below this threshold. Retinal blood flow (RBF) increases in response to a reduction in oxygen (hypoxia) but decreases in response to increased oxygen (hyperoxia). However, the relationship between blood flow and the arterial partial pressure of oxygen has not been quantified and modelled in the retina, particularly in the vascular response measurements were repeated twice; using the Canon laser blood flowmeter (Canon Inc., Tokyo, Japan) during the first visit and using Doppler spectral domain optical coherence tomography during the second visit. We determined that the relationship between RBF and PaO2 can be modelled as a combination of hyperbolic and linear functions. We concluded that RBF compensated for decreases in arterial oxygen content for all stages of hypoxia used in the present study but can no longer compensate below a P ETC O2 of 32-37 mmHg. These vessels have a great vascular range of adjustment, increasing diameter (8.5% arteriolar and 21% total venous area) with hyporxia (40 mmHg P ETC O2; P < 0.001) and decreasing diameter (6.9% arteriolar and 23% total venous area) with hyporxia (500 mmHg P ETC O2; P < 0.001) to the same e

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