

Effect of Temperature on the Thickness of the Ocular Choroid

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Background

The choroid of the eye is implicated in stabilizing the temperature of the retina. However, little is known about this thermoregulatory function of the choroid.

Aim

To investigate the time-course and amplitude of thickness responses of the choroid induced by changes in temperature of the ocular adnexa.

Methods

In 20 healthy subjects (14 females, age: 23 ± 3 years), either a heat or ice pack were applied to each subject's closed eyes for 10 minutes (*treatment period*).

After 10 minutes, the packs were removed, and the eyes were monitored for a further 15 minutes (*recovery period*).

Eyelid surface temperatures were monitored with thermal probes before heating/cooling, then repeated every 2 minutes during the treatment period, and every 5 minutes during the recovery period.

Optical coherence tomography chorioretinal images were taken in both eyes before and after heating or cooling, then repeated every 5 minutes.

Thicknesses were measured using a semi-automatic segmentation method, and changes in choroidal and retinal thickness were compared between the cooled and the warmed eye.

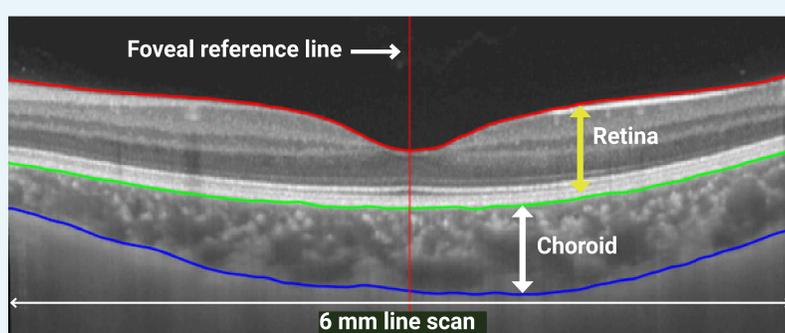
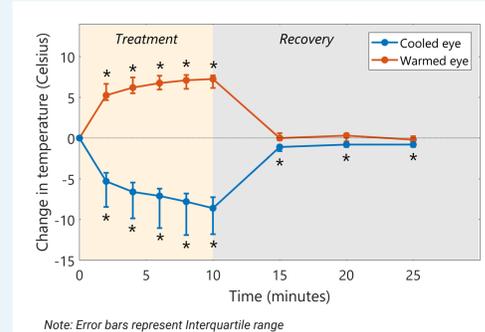


Fig. OCT image of the retina and the choroid

Results

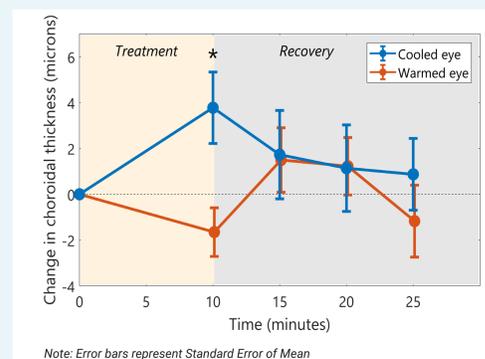
Eyelid surface temperature



Significant difference in changes of eyelid surface temperature between the cooled & warmed eye during treatment period (all $p < 0.01$).

Surface temperature rapidly returned to baseline during the recovery period.

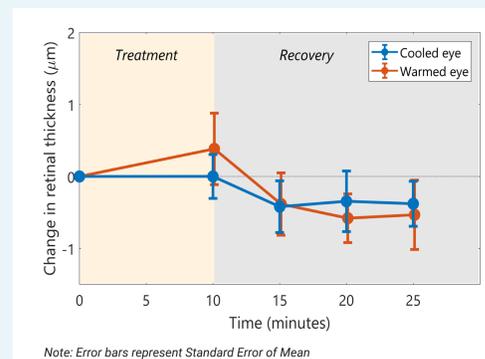
Choroidal thickness



Significant difference in choroidal thickness changes between the cooled & warmed eye after 10 minutes ($5.43 \mu\text{m}$ [$+1.93$ to $+8.92$], $p = 0.004$).

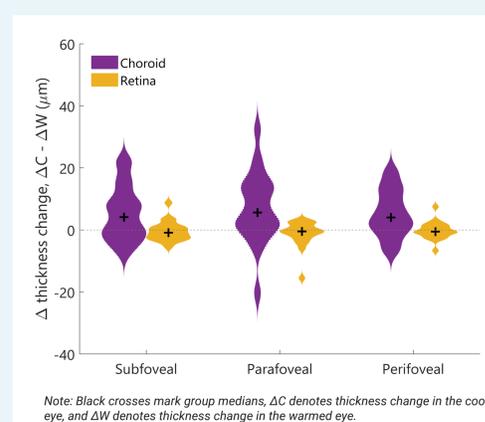
Significant increase in choroidal thickness of the cooled eye ($+3.78 \mu\text{m}$ [$+1.07$ to $+6.89$], $p = 0.026$).

Retinal thickness



No significant changes in retinal thickness with either cooling ($+0.00 \mu\text{m}$ [-0.638 to $+0.639$], $p = 0.999$) or warming ($+0.38 \mu\text{m}$ [-0.65 to $+1.42$], $p = 0.450$) of the ocular adnexa.

Sectoral choroidal and retinal thickness



Significant increases in thickness of central ($p = 0.030$), parafoveal ($p = 0.010$), and perifoveal ($p = 0.010$) choroid in the cooled eye relative to the warmed eye after 10 minutes of treatment..

No significant changes in retinal thickness in any of the regions.

Conclusion

Cooling the ocular adnexa caused a small but statistically significant increase in choroidal thickness, whereas warming the ocular adnexa did not affect the thickness. These findings suggest that the choroid modulates its thickness rapidly and transiently in response to local temperature changes, among many other factors.

Given the choroid's thermoregulatory role, changes in thickness induced by temperature are presumably mediated by changes in blood flow. However, the exact mechanism underlying these choroidal responses to temperature, and their potential implications in the field of ischemia and/or myopia control remain to be investigated.