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Correlation of low frequency waves in retinal vessel width and arterial blood pressure

Daniel Baumgarten; Steffen Rieger; Lisanne Lüken; Stefanie Freitag; Dietmar Link; Sascha Klee

— Author Affiliations & Notes

Daniel Baumgarten
Institute of Biomedical Engineering and Informatics, Technische Universität Ilmenau, Ilmenau, Germany

Steffen Rieger
Institute of Biomedical Engineering and Informatics, Technische Universität Ilmenau, Ilmenau, Germany

Lisanne Lüken
Institute of Biomedical Engineering and Informatics, Technische Universität Ilmenau, Ilmenau, Germany

Stefanie Freitag
Institute of Biomedical Engineering and Informatics, Technische Universität Ilmenau, Ilmenau, Germany

Dietmar Link
Institute of Biomedical Engineering and Informatics, Technische Universität Ilmenau, Ilmenau, Germany

Sascha Klee
Institute of Biomedical Engineering and Informatics, Technische Universität Ilmenau, Ilmenau, Germany

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Abstract

Purpose : Static and dynamic retinal vessel analysis are promising tools for early risk evaluation of cardiovascular diseases. The temporal biological variation of retinal vessels leads to uncertainties in this analysis. A correlation to blood pressure is described in literature and commonly demonstrated by discrete measurements with a sampling rate in the minute range. We investigated the temporal correlation of retinal vessel width and arterial blood pressure in the range of the low frequency waves in a multimodal measurement study to gain an understanding of the temporal relation.

Methods : Retinal vessels were recorded by Dynamic Vessel Analyzer (IMEDOS Systems UG, Jena). Simultaneously, the arterial blood pressure was recorded by a continuous blood pressure measurement device (Finapres Medical Systems B.V., Amsterdam, NL). From the retinal vessel diameters, the equivalent values of arterial and venous vessel diameters CRAE and CRVE were calculated and the Mayer waves around 0.1Hz are extracted by filtering. Temporal dependencies were determined by cross correlation, time values of the minimum and maximum correlation were extracted in each measurement. The median values, the quartiles and the interquartile range (IQR) were calculated for the whole dataset.
We performed measurements on 15 young and healthy subjects. Within a time period of 90 minutes, six repeated measurements with a duration of six minutes each were conducted.

Results : Cross correlation yielded clear dependencies in most of the 87 datasets. The statistical results were: minima of arteries: median -3.92 s, IQR 1.66, maxima of arteries: median -0.05 s, IQR 7.45, minima of veins: median -4.77 s, IQR 2.18, maxima of veins: median -0.32 s, IQR 0.45. Most of the determined time shifts of the minima of the arteries and maxima of the veins are very close together but some measurements

show outliers with random time shifts. 73.6% of the minima of arteries are in a range of +-2 s and even 85.1% of the maxima of veins are in a range of +-1 s around the median value. Most outliers are concentrated on a few subjects. Outliers for arterial and venous correlation are not necessarily related.

Conclusions : The measurements show clear dependencies between Mayer waves in retinal vessel width and arterial blood pressure. The best correlation can be seen on minima of arteries and maxima of veins, yielding the smallest variation and the smallest number of outliers.

This is an abstract that was submitted for the 2016 ARVO Annual Meeting, held in Seattle, Wash., May 1-5, 2016.