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Dorzolamide-Timolol Combination and Retinal Vessel Oxygen Saturation in Patients with Glaucoma or Ocular Hypertension

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Purpose

The purpose of this study was to examine whether the addition of dorzolamide to timolol monotherapy influences oxygen saturation in the human retina

Methods

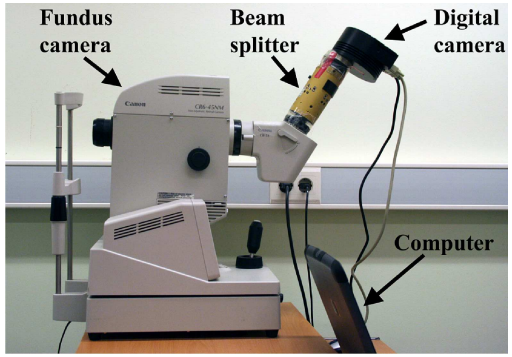

Figure 1. The retinal oximeter

Our automatic retinal oximeter [1] is based on a fundus camera. It yields fundus images with 4 wavelengths of light simultaneously. Two wavelengths, 605nm and 586nm, are used for calculation of oxygen saturation. Specialized software automatically selects measurement points on the oximetry fundus images and estimates the oxygen saturation in retinal vessels.

Twenty patients with open angle glaucoma (11) and ocular hypertension (9) were recruited. The patients were randomised into receiving timolol monotherapy or dorzolamide-timolol combination for an 8 month test period, followed by a second test period, before which the patients switched treatments. Oximetry measurements were performed at 2 month intervals during each period. Of the 20 patients, 13 followed the study protocol into the second test period and 10 managed all study visits.

Results

Table 1 Oxygen saturation in retinal vessels and other physiological parameters during the two different drug treatments. Pooled data; n=13 (mean±SD)

	Dorzolamide-timolol combination	Timolol monotherapy
Arteriolar oxygen saturation	97 ± 2 %	96 ± 2 %
Venular oxygen saturation	66 ± 5 %	65 ± 6 %
Arterio-venous oxygen saturation difference	31 ± 4 %	31 ± 5 %
Intraocular pressure*	14 ± 2 mmHg	17 ± 3 mmHg
Mean arterial blood pressure	96 ± 11 mmHg	98 ± 9 mmHg
Ocular perfusion pressure	49 ± 6 mmHg	49 ± 6 mmHg

*Significant difference (paired t-test, p = 0.001)

Table 2 Oxygen saturation in retinal vessels categorised by order of drug treatments (mean±SD)

Timolol in first period (n = 7)

	Timolol monotherapy	Dorzolamide-timolol combination
Arterioles	97 ± 2 %	96 ± 2 %
Venules	64 ± 7 %	64 ± 5 %
A-V difference	32 ± 5 %	32 ± 4 %

Dorzolamide-timolol in first period (n = 6)

	Dorzolamide-timolol combination	Timolol monotherapy
Arterioles	98 ± 2 %	95 ± 2 % **
Venules	69 ± 5 %	66 ± 6 % *
A-V difference	29 ± 4 %	30 ± 5 %

Significant at * p < 0.05 or ** p< 0.01 as tested with Bonferroni post-tests

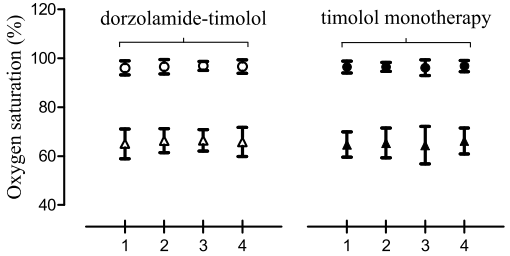

Figure 2. Mean and standard deviation for retinal oxygen saturation at visits 1 through 4 during each of the drug treatments. Circles show arteriolar oxygen saturation, while triangles indicate venular saturation. Each visit is separated by about 2 months and the total length of the study is about 18 months, including washout periods.

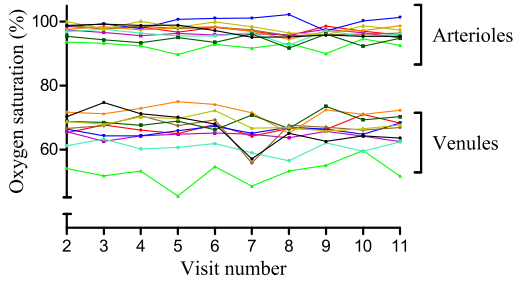

Figure 3. Each line links the measurements made on one individual. The upper group of lines shows the arterioles and the lower shows the venules. The same colour is used for arterioles and venules of the same individual.

Discussion

Adding dorzolamide to timolol monotherapy has minimal effect but going from dorzolamide-timolol combination to timolol alone lowered both arteriolar and venular oxygen saturation by three percentage points. It is not clear why the results are different depending on the order of the drug treatments.

Unchanged retinal oxygen saturation does not preclude that dorzolamide has an effect on retinal oxygen metabolism. Previous studies have reported an increase in retinal blood flow of up to 21% after topical administration of dorzolamide [2,3] . Oxygen delivery is equal to the product of retinal blood flow and arterio-venous oxygen content difference and unchanged oxygen saturation and increased blood flow would indicate increased oxygen delivery to the retina.

There is a remarkable stability in the saturation values over an extended period of time indicating that our non-invasive retinal oximeter provides reliable measurements (see figures 2 and 3). Furthermore, this shows that the oxygen saturation in retinal blood vessels remained stable during the study.

References

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Commercial relationship:
S. Traustason: Oxymap (E), S.H. Hardarson: Oxymap (I,E,P), M.S. Gottfreðsdóttir: None, T. Eysteinsson: Oxymap (I,P), R.A. Karlsson: Oxymap (I,E,P), E. Stefansson: Oxymap (I,P), A. Harris: Oxymap (C).

Support:
Merck

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