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Large diurnal variation of intraocular pressure in open angle glaucoma in subjects with type a behaviour pattern

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Abstract

Aim: To evaluate the possible causes of the greater perimetric damage found in OAG subjects with type A behaviour and the possible role of psycho-physiological stress.

Materials and methods: 80 patients with OAG, 44 women and 36 men, 40 with type A behaviour and 40 with type B studied with the Type A/B Personality Questionnaire (A modified version of the Jenkins Activity Survey), underwent a complete ophthalmologic examination consisting of bio-microscopy, tonometry and daily tonometric curve, examination of the visual field by means of Octopus 1-2-3 computerised perimeter and its assessment with the Glaucoma Staging System 2 (GSS2), morphological monitoring of the Retinal Nerve Fibre Layer (RNFL) with GDxVCC and monitoring of arterial tension (times 8.30 am–10.30 am–12.30 pm–3 pm–5 pm and 7 pm) with a UA-1010 automatic Digital Blood Pressure Monitor device.

Results: In subjects with type A behaviour fluctuation in IOP values is observed in the daytime hours in concomitance with similar oscillations in arterial pressure values. In the subjects with type B behaviour both IOP and the arterial pressure values remain more or less constant with oscillations that are not statistically significant. In GSS2 more significant impairment of the visual field is observed in subjects with type A behaviour. In the same subjects, GDxVCC examination shows statistically significant impairment of the values. The NFI index is positively correlated with the perimetric damage (r=0.74).

Conclusions: Personality study is an extremely important part of the diagnostic work-up and treatment of OAG. The frequent oscillations in IOP observed in subjects with type A behaviour could constitute a risk factor in the evolution of perimetric damage.

Keywords: Type a behaviour pattern, open angle glaucoma, intraocular pressure, perimetric damage, arterial pressure

Introduction

Intraocular pressure (IOP) constitutes the best-known and most widely studied risk factor of chronic open angle glaucoma (OAG); its daily oscillations, superior to 4-6 mm Hg, are believed to constitute an independent risk factor 1 for determination of damage to the optic nerve.

Study of the variations in intraocular pressure through a tonometric curve has made it possible to identify four types according to the time of day at which the maximum peaks are observed. The tonometric curve has also highlighted the fact that in subjects with a "morning type" curve (maximum values between 4 am and 8 am) or "night type" (maximum values between midnight and 4 am), the finding of normal values in daytime hours can lead to the erroneous conviction that the therapy being applied is effective.

In subjects with a "day type" curve, with the peak between 3 pm and 6 pm, there may also be bigger oscillations of the IOP in that it is affected by the action of other factors and in particular by oscillations in arterial tension.

The fact is that arterial hypertension causes a series of alterations of haematic flow at the papillary level, whose final result is an increase in vascular resistance and damage to self-regulation mechanisms that are very important for the maintenance of haematic flow in different physio-pathological conditions [1-6].

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Some studies [7,8] have also demonstrated that during isometric exercise there is agreement between oscillations in arterial tension and oscillations in intraocular pressure.

The literature has consolidated the bond between personality, stress (acute and chronic) and cardiovascular pathology and shown that type A behaviour, according to the classical definition by Friedman and Rosenman, exposes the subject to negative influence of stresses with a higher and more prolonged arterial pressure response. The frequent daily oscillations in arterial tension, present in subjects with type A behaviour, could therefore also have an influence at an ocular level, with consequent greater fluctuations in intraocular pressure.

In a preceding study we stressed that in OAG subjects with type A behaviour more evident perimetric damage is observed in the presence of apparently efficient therapeutic treatment. The object of this study is to seek the possible causes of this greater perimetric damage.

Materials and methods

80 patients with OAG, 44 women and 36 men, consecutively coming to the clinic for Glaucoma of the Institute of Ophthalmology of the University of Palermo from November 2008 to October 2012, without significant differences regarding duration of illness from clinical diagnosis, were studied. The average age was 61.15±14.6 without significant differences between the two sexes.

The patients were being treated with beta blockers and/or prostaglandin and/or carbonic anhydrase inhibitors. The study was conducted in agreement with the ethical standards laid down in the Helsinki Declaration and all the subjects spontaneously participated in the clinical study, signing an informed consent.

At the time of first medical examination of the patients, 40 of which had type A behaviour and 40 type B to be studied with the Type A/B Personality Questionnaire (Modified version of Jenkins Activity Survey), underwent the following :

1. Complete bio-microscopic examination.
2. Daytime tonometric curve (8.30 am–10.30 am–12.30 pm–3 pm–5 pm and 7 pm) with measurements made with a Goldmann applanatio tonometer.
3. Examination of the visual field with Octopus 1-2-3 computerized perimeter and its evaluation through Glaucoma Staging System 2 (GSS2) [8].
4. Morphological monitoring of the thickness of the retinal nervous fibres layer (RFNL) with GDxVCC.
5. Monitoring of arterial tension (8.30 am–10.30 am–12.30 pm –3 pm–5 pm and 7 pm) with an automatic UA-1010 Digital Blood Pressure Monitor device.

Statistical analysis

The data are expressed as average±SD. To evaluate the significance of the differences in IOP between the two groups, Student's test t was used.

The correlation between impairment of the visual field and NFI Index was examined through analysis of linear and express regression as a Pearson's correlation coefficient (*r*). P values <0.05 were considered statistically significant.

Results

Table 1 gives the values (MD±DS) of the tonometric curve in the two groups.

Figure 1 clearly shows that in subjects with type B behaviour the IOP values are maintained more or less constant in the hours of observation, whereas in those with type A behaviour there is instability that reaches its peak at 5 pm. The difference between the averages of the two groups proved significant in checks made at 10.30 am, 3 pm and 5 pm.

Table 1. Average values of the tonometric curve in the two groups.

Time	Tipo A	Tipo B	p
8.30 am	20.8±1.88 mm Hg	19.4±1.58	0.006
10.30 am	16.7±2.34	19.8±1.74	0.0001
12.30 pm	20.6±1.58	20.1±1.33	0.130
3 pm	22.1±2.01	19 3±1.52	0.0001
5 pm	23.6±1.47	20.0±2.21	0.0001
7 pm	18-8±1.71	18.4±1.86	0.320

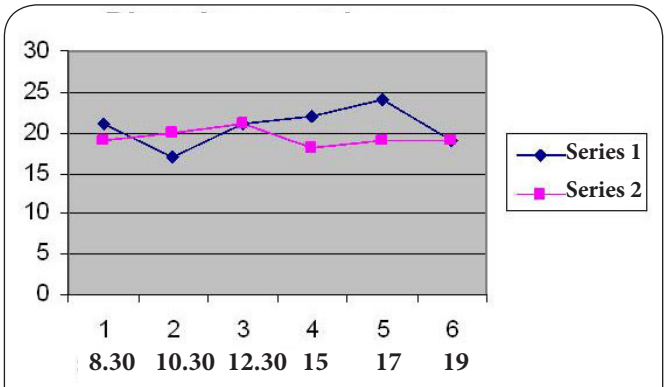

Figure 1. Diurnal tonometric curve.
Series 1: Subjects with type A behaviour.
Series 2: Subjects with type B behaviour.

At the time of the first medical examination, the study of the visual field highlights impairment of the GSS2 [9], statistically more significant (p=0.001), in type A subjects (2.58±0.52) compared to those of type B (1.61±0.64).

At the time of the first examination, the GDxVCC examination, the values of TSNIT, though in the normal range (45.6-66.8), are statistically higher (p>0.001) in type B subjects; indeed, the latter have an average middle value of 62 as against 49 found in type A subjects.

The NFI index, which positively correlates with the perimetric damage (r=0.74), instead proves to be statistically higher in

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type A subjects (p=0.01); in these subjects the average value was 47 (Range 34-52) against the value of 35 (Range 30-43) found in type B subjects. **Table 2** shows the average values of arterial tension observed in the two groups at the same times as the check on IOP.

As we can see from **Table 2**, in the subjects with type A behaviour in the daytime hours the arterial tension shows major oscillations, whereas in the subjects with type B behaviour these oscillations are insignificant.

Table 2. Average values of arterial tension in the two groups.

Time	Tipo A	Tipo B	p
8.30	132±4.28 mm Hg	133±2.56	0.209
10.30	131±4.76	132±3.22	0.271
12.30	134±8.16	132±2.68	0.145
15.00	135±4.48	132±2.72	0.001
17.00	138±5.72	133±1.44	0.001
19.00	132±2.48	133±2.50	0.093

Discussion

Subjects with type A behaviour easily have cardiovascular pathologies and in particular coronary illness. The systemic arterial tension in these subjects also shows a more rapid evolution with more evident organ complications because of its big daytime variations despite the more careful therapeutic treatments; the fact is that the characteristic state of anxiety of these subjects exposes them to repeated solicitations causing rises in arterial tension of various mm of Hg [**10**].

It is now consolidated in the literature that IOP is influenced by systemic arterial tension and various studies have also stressed a positive correlation between systemic arterial tension and IOP in subjects with systemic arterial hypertension [**2**,**11**,**12**].

Sung et al., [**13**] highlighted the fact that in subjects with OAG a fluctuation of systemic arterial tension in the 24 hours is probably associated with a greater risk of progressive reduction of the visual field because of the greater oscillation in the pressure of ocular perfusion in such subjects.

Werne et al., [**14**], after a review of the literature, confirms that variations in arterial tension, especially big oscillations, negatively affect haematic ocular flow, involving an additional risk in the evolution of glaucoma.

Bakke et al., [**7**] were also able to observe in volunteers with normal tension, during isometric physical exercise, a gradual parallel increase of systemic and intraocular pressure with an average increase, for IOP, of 3.6±0.8 mm Hg/min, and with a 25% increase (P<0.005) in comparison to basal values.

Further, it is known that fluctuation in intraocular pressure constitutes a risk factor for the progression of the damage to the visual field in OAG [**3**,**13**,**14**].

In a preceding study [**16**] we noticed that subjects with type A behaviour have wider parametric damage than those with type B behaviour, and it was hypothesized that it could be connected with the state of anxiety present in such subjects; in the latter, indeed, one notices, more marked trait anxiety that primarily affects female subjects, in a statistically significant way. In such subjects morphological damage to the optical papilla documentable in GDxVVC has also been found, its NFI index positively correlating with the perimetric damage evaluated in GSS2.

The study of the daytime tonometric curve made it possible to highlight in subjects with type A behaviour oscillations in IOP with a difference between minimum value and maximum value of 6.4 mm Hg, while in subjects with type B behaviour the curve is flat, with differences not above 1 mm Hg.

In our opinion, the repeated oscillations in IOP mentioned could be at the basis of the greater perimetric damage shown.

The state of anxiety, both state and trait, more marked in subjects with type A behaviour, submits them to conditions of particularly abnormal distress with hyper-activation of the cortical-adrenergic system, giving rise to repeated daily systemic arterial tension peaks [**10**], which, as already stated, can have repercussions on IOP.

The subjects with type A behaviour in our sample also exhibit large oscillations of arterial tension with a peak at 5 pm, when the IOP values are highest.

The increase in IOP could also be linked to the action of catecholamines on the beta-2 receptors located in the unpigmented epithelium of the ciliary bodies, which, as is well-known, [**17**] involves increased synthesis of cyclical AMP (AMPc) with a consequent increase in the production of aqueous humour, one of the factors on which intraocular pressure depends.

It is also to be noticed that only monitoring of IOP has made it possible to ascertain that its values, though not differing from those found in subjects with type B behaviour at the first morning check (8.30 am), during the day exhibited an increase, in some subjects reaching decidedly high values (>25 mm Hg) with statistically significant differences between the two groups. In our opinion, it follows that study of the tonometric curve, especially in subjects with type A behaviour, is an essential diagnostic investigation, to be carried out at all times and not only at diagnosis but also in follow-up.

Conclusion

Though with the prudence that the limitedness of the sample involves, we can affirm that the more accentuated perimetric damage found in our OAG subjects with type A behaviour is very probably linked to the more frequent IOP oscillations. In our opinion, in the study of OAG subjects, typing of patient behaviour should be included for more thorough management of both clinical examination and therapy.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

Authors' contributions	RMB	DMB
Research concept and design	✓	--
Collection and/or assembly of data	✓	✓
Data analysis and interpretation	✓	✓
Writing the article	✓	--
Critical revision of the article	--	✓
Final approval of article	✓	✓
Statistical analysis	✓	✓

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