TARGET PRESSURES IN GLAUCOMA

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SUMMARY

Despite exciting progress in the field of neuroprotection, lowering the intraocular pressure is still the only available option to treat glaucoma patients. The level to which the intraocular pressure should be lowered is different for each individual patient. The formula proposed to calculate the "target pressure" takes into account the pressure at which the glaucomatous damage presumably occured (the "maximum pressure") and the risk of future damage. This target pressure should be re-evaluated periodically.

RESUME

Malgré la recherche intense dans le domaine de la neuroprotection, la réduction de la pression intraoculaire est encore toujours le seul moyen à notre disposition pour traiter les patients glaucomateux. La pression cible est différente pour chaque patient. La formule que nous proposons est basée d'une part sur la pression qui a probablement provoqué les défits glaucomateux (la pression maximale), et d'autre part sur le risque de voir ces déficits progresser. La pression cible calculée devra être réévaluée périodiquement.

KEY WORDS

Target pressure, intraocular pressure, glaucoma.

MOTS CLES

Pression cible, pression intra-oculaire, glaucome.

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Figure 1 Rates of progression of glaucomatous damage. Mostly, progression is parabolic with a slow rate in the beginning and a much faster rate at the end of the disease (red). Sometimes it is linear with a rate correlating with the level of IOP, but not necessarily leading to visual impairment (white/pink). Sometimes the rate of progression can stop without noticeable change in the level of IOP (yellow).

BACKGROUND AND RATIONALE

Despite exciting progress in the field of neuroprotection, lowering the intraocular pressure (IOP) is still the only available option to treat glaucoma patients. Several studies have shown that lowering the IOP is beneficial for glaucoma patients, even in normal tension glaucoma. It was even suggested that early surgery was more advantageous than medical treatment[4,6]. Early surgery has the additional benefit of improving the lifestyle of the patient who does not have to adhere to a tight schedule of medication and is not exposed to the side-effects of the drugs. The American Ocular Hypertension Study and the European Glaucoma Prevention Study are currently testing the supposition that lowering the IOP is also beneficial for patients with ocular hypertension[7].

The rate of progression of glaucomatous damage is different for each patient and is illustrated in Figure 1. Mostly, progression is parabolic with a slow rate in the beginning and a much faster rate at the end of the disease[13]. Sometimes it is linear with a rate correlating with the level of IOP, but not necessarily leading to visual impairment. Sometimes the rate of progression can stop without noticeable change in the level of IOP. Conversely we also know that progression can continue, at least for a while, even after having drastically lowered the IOP, for example after filtering surgery. This is often the case in advanced glaucoma. It is therefore important to document progression as early as possible and to find out the rate of progression for every individual patient[8]. This information will allow the clinician to treat early and to know how aggressive one should be in lowering the IOP. Figure 2 illustrates the rate of ganglion cell loss by aging compared to glaucoma. The natural loss of ganglion by aging is approximately 0.4% loss per year. The rate of ganglion cell loss in glaucoma varies between 1 and 4% per year[1,13]. Early visual field defects are usually detectable after a loss of 40% of gang-

Figure 2 Rate of ganglion cell loss by aging compared to glaucoma. The natural loss of ganglion cells by aging is approximately 0.4% loss per year. The rate of ganglion cell loss in glaucoma varies between 1 and 4% per year. Early visual field defects are usually detectable after a loss of 40% of ganglion cells. This means that usually the visual field defects are detectable after 10 years of disease.

lion cells. This means that usually the visual field defects are detectable after 10 years of disease. This means also that every non-glaucomatous patient will ultimately develop glaucomatous visual field defects provided he or she will live at least for 100 years. By lowering the IOP one tries to bend the curve of glaucomatous loss towards the curve of loss by aging. The degree to which the IOP should be lowered to obtain this goal is unfortunately unknown. Until the day we can use optic disc or visual field improvement as endpoints we have no criterion for IOP reduction unless we set a target pressure[5].

HOW TO CALCULATE A TARGET PRESSURE

Several methods have been used in practice and in clinical studies. Obviously the lowest possible pressure will be the safest for preventing further glaucomatous damage. But extreme low pressures may have drawbacks, and the medications necessary to obtain them have potential side effects. Everybody agrees now that using a number (e.g. < 21mm Hg) is obsolete, because it does not take into account the individual variability for each patient. Many studies have used a percentage (e.g. a reduction of at least 20%)[9,10]. This approach is attractive but does not take into account the risk of further damage. The greater the risk of further damage, the lower the IOP should be. The risk of further damage is related to the degree of damage already present and the IOP at which glaucomatous damage presumably occurred (″Maximum IOP″). A useful algorithm is a variation of the formula proposed by H. Jampel: ″Target IOP = Maximum IOP - Maximum IOP% - Z″, where Z is an optic nerve damage severity factor[3]. The grading scale used by H. Jampel to define the factor Z is shown in Table 1. For example an eye with a maximum IOP of 30 mm Hg, optic nerve damage and visual field loss not threatening fixation would have a target set at 19 mm Hg (30 - 30% - 2). The tar-

Z	Optic Nerve Damage
0	Normal disc & Normal Visual Field
1	Abnormal Disc & Normal Visual Field
2	Visual Field Loss not threatening fixation
3	Visual Field Loss threatening or involving fixation

Table 1. Grading scale to define the optic nerve damage severity factor Z

get pressure might be adjusted by including other risk factors such as age, race, burden of therapy, and IOP range.

HOW TO USE A TARGET PRESSURE

It is recommended to record and highlight the target pressure in the chart of a patient. This is particularly useful when the care of the patient is shared by several ophthalmologists. If not written down there is a natural tendency to drift upward the target pressure. It is therefore very practical to draw an IOP curve for each glaucomatous patient and to highlight the target pressure on the curve. The target pressure should be reevaluated periodically. It is clear that the target pressure needs to be lowered if glaucomatous damage is progressing despite IOP's below the initially set target. Conversely the target pressure may need to be adjusted upward, decreasing the side-effects of some medications, if the optic nerve and the visual field remain stable for a prolonged period. It is probably wise to keep in mind a target range instead of a target pressure since it is unlikely that therapy will be modified on the basis of a 1 mm Hg change. For the same reasons it is judicious to use multiple IOP measurements before deciding that a modification of therapy is necessary. The IOP measurements should be taken at different hours of the day, especially when progression of damage is suspected. Let us also remember that IOP ranges of more than 5 mm Hg are considered as an additional risk factor. For those reasons home tonometry might be very useful[12]. We should also keep in mind that IOP readings can be over- or underestimated[11]. After refractive surgery for example the aplanation tonometry is underestimated; because the cornea is thinner after excimer and lasik, and because the cornea is flatter after radial keratotomy. When the cornea is thicker the IOP may be overestimated. Several studies have shown that patients with ocular hypertension have thicker corneas. Hence pachymetry might be useful in patients with ocular hypertension[2]. Compliance is a limitation in using target pressures because the IOP measurements do not always reflect the real IOP fluctuations in a non-compliant patient. Fixed combinations of drugs are certainly beneficial for patients with poor compliance. Side-effects of the medication should always be taken into consideration, and if the target pressure can not be reached with maximal tolerable medical therapy, surgery should be considered.

CONCLUSION

The concept of using a target pressure in glaucoma is based on the fact that no other treatment is available at this moment and that it is unknown to what extent the IOP should be lowered to stop progression for each individual patient. The target IOP is assessed by taking into account the risk of future damage and should be reevaluated periodically. If the pressure goal can not be reached medically or if the drug or combination of drugs have side effects surgical treatment should be considered. Above all it is important to estimate the slope of progression for each individual patient in order to minimize the risk of treatment being it medical or surgical. Finally I hope we shall have in the near future the means to treat the other risk factors resulting in optic nerve damage.

REFERENCES

(1) Airaksinen, P., Tuulonen, A., Alanko, H., Rate and pattern of neuroretinal rim area decrease in ocular hypertension and glaucoma. Arch Ophthalmol, 1992, 110, 206-210.

(2) Herndon, L., Choudri, S., Cox, T., Damji, K., Shield, M., Allingham, R., Central corneal thickness in normal, glaucomatous, and ocular hypertensive eyes, Arch Ophthalmol, 1997, 115, 1137-1141.

(3) Jampel, H., Target pressure in glaucoma therapy, J Glaucoma, 1997, 6, 133-138.

(4) Jay, J., Murray, S., Early trabeculectomy versus conventional management in primary open angle glaucoma. Br J Ophthalmol, 1988, 72, 881-889.

(5) Katz, L., Spaeth, G., Cantor, L., Poryzees, E., Steinmann, W., Reversible optic disc cupping and visual field improvement in adults with glaucoma. Am J Ophthalmol, 1989, 107, 485-492.
(6) Migdal, C., Gregory, W., Hitchings, R., - Long-term functional outcome after early surgery compared with laser and medicine in open-angle glaucoma. Ophthalmol, 1994, 1651-1657.
(7) Miglior, S., Pfeiffer, N., Cunha-Vaz, J., Zeyen, T., European Glaucoma Prevention Study Group. The European Glaucoma Prevention Study. Objectives and Methods. Invest Ophthalmol Vis Sci Suppl 1999, 40(4), S566, abstract n° 2984
(8) Spaeth, J., Year Book of Ophthalmology, 1997, Mosby. R. Wilson, editor, 1997, 70-71.
(9) The Fluorouracil Filtering Surgery Study Group, Fluorouracil Filtering Surgery Study one year follow-up, Am. J. Ophthalmol, 1989, 108, 625-635.
(10) The Glaucoma Laser Trial Research Group, The Glaucoma Laser Trial (GLT)2, Results of argon laser trabeculoplasty versus topical medicines, Ophthalmology, 1990, 97, 1403-1413.
(11) Whitacre, M., Stein, R., Sources of error with use of Goldmann-type tonometers, Surv Ophthalmol, 1993, 38, 1-30.
(12) Zeimer, R., Wilensky, J., Gieser, D., Viana, M., Association between intraocular pressure peaks and progression of visual field loss, Ophthalmology, 1991, 98, 64-69.
(13) Zeyen, T., Caprioli, J., Progression of disc and field damage in early glaucoma. Arch Ophthalmol 1993, 111, 62-65.

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