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Glaucoma care optimised in an ageing population

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CHAPTER 8

General Discussion

The United Nations World Population Prospects 2015 state that globally, the population aged 60 or over is the fastest growing. In 2015, there were 901 million people aged 60 or over, comprising 12 per cent of the global population. Rapid ageing will occur in all parts of the world, so that, by 2050, all major areas of the world except Africa will have nearly a quarter or more of their populations aged 60 or over. The number of older persons in the world is projected to be 1.4 billion by 2030 and 2.1 billion by 2050. Age is a well-recognized risk factor for glaucoma incidence and prevalence.¹⁻⁴ Given that glaucoma is typically a disease of the elderly, it is to be expected that the total burden of glaucoma will increase in the upcoming decennia. And indeed, it is estimated that the number of people with glaucoma will increase from 64.3 million in 2013 to 111.8 million in 2040, which is nearly a doubling.⁵ The world population, in comparison, will grow with about 25% in the same time span according to the UN World Population Prospects.

With the growing elderly population it is of extreme importance to optimize healthcare in general, and, in the light of this thesis, glaucoma care in particular. In optimized care, all things are done that are needed for high-quality health care, but on the other hand, all tests, treatments and other medical actions that do not contribute to the patients outcome are omitted. In the chapters 2 through 5 of this thesis, I contributed to this mainly by finding ways to optimize perimetry and perimetric follow-up of glaucoma patients. Chapter 6 and 7 explore the boundaries of glaucoma care for the elderly.

Improving Care for Glaucoma Patients - a Summary of Findings

Perimetry is invaluable for glaucoma care,⁶⁻⁹ but it is also time-consuming (and thus expensive) and can be cumbersome for the patient as well as the examiner. When visual field tests are taken, the next step is to interpret them correctly. **Chapter 2** demonstrates that Nonparametric Progression Analysis (NPA), which is a relatively simple to use algorithm, can be used to identify visual field progression in all stages of glaucoma. This algorithm is one of many different methods described in literature to detect visual field progression. Importantly, not a single one is perfect¹⁰ and it was shown that agreement between these methods is disappointing.¹¹ This poor agreement was previously confirmed among other methods.^{12,13} The biggest advantage of NPA is that no special software is needed and the algorithm can

theoretically be used for all types of perimeters. Furthermore, it is highly reproducible, unlike subjective assessments of a series of visual fields. Finally, its value was also shown by the construct validity presented in **chapter 3**. Here, it was confirmed that intraocular pressure (IOP) is a prognostic factor for progressive visual field loss as assessed with NPA in glaucoma patients, which is to be expected since IOP is one of the most consistent risk factors for visual field progression in the literature.

The first study in this thesis (**chapter 2**) also learned that the average glaucoma patient included in the Groningen Longitudinal Glaucoma Study (GLGS) progressed with a mean rate of -0.25 dB per year, which is in good agreement with other glaucoma studies.^{14,15} This supports the idea that the GLGS population is a good reflection of the western glaucoma population under care as a whole.

Besides IOP, two other factors were found to be robust independent risk factors for glaucomatous visual field progression being age and more advanced disease stage. As discussed in **chapter 3**, these three factors are among the most confirmed prognostic factors for progressive glaucoma in the literature. In previous reports on this topic, different statistical approaches to risk factor analysis were being used. Among them were several univariable and multivariable analysis techniques. We found that the statistical approach applied did not change the main conclusions of our risk factor analysis. This is a comforting thought in a time when data-massaging is only a few mouse clicks away.

Knowledge of risk factors for visual field progression creates the opportunity to optimize glaucoma care. More intensive follow-up and/or treatment is required for patients with higher IOP, higher age, or more advanced glaucoma than for those less at risk of deterioration. For example, a 55 year old patient with early open-angle glaucoma and an IOP of 12 mmHg may have to visit the ophthalmologist less frequent than does a 72 year old patient with moderate open-angle glaucoma who has an IOP of 18 mmHg.

Despite age being an important risk factor for progression, the risk for visual field progression for elderly patients is to be placed in the light of the risk of becoming visually impaired in the remaining years to live. This is especially true since glaucoma is relatively slowly progressive, with the vast majority of treated patients

showing deterioration in Mean Deviation (MD) slower than 1 dB per year. In **chapter 6 and 7** it can be read that up to 80 years of age, all patients need full glaucoma care if their progression velocity is unknown. Above 80 years of age, the follow-up or treatment regimen can be made less strict, if the visual field status permits. For example, If the above mentioned patient with early open-angle glaucoma and an IOP of 12 mmHg would be 88 instead of 55, he or she does not need the intensive perimetric follow-up to prevent the patient from visual impairment. When the individual visual field progression velocity is known, more patients can be said never to reach blindness during their lives (**chapter 7**). This creates the opportunity to even better tailor the intensity of glaucoma care. Consequently, following patient using standard automated perimetry (SAP) is very useful, both for the primary estimation of the risk for blindness as well as for the calculation of the progression rate, which in turn makes a more accurate estimation of the risk for blindness possible. However, for calculating the rate of progression, a 5 year follow-up with SAP is required.¹⁶ For that reason, for the elderly glaucoma patient the physician should carefully consider the usefulness of perimetric follow-up. In Groningen - as a rule of thumb - perimetric follow-up is not started for new glaucoma patients over 80 years of age, but is continued if the patient started SAP tests before the age of 80, as long as it is considered useful.

Another way to optimize glaucoma care is to choose the right testing modality for the right patient. For instance, in a previous study it was shown that glaucoma suspect patients do not need SAP per se, since Frequency doubling perimetry (FDT) can detect glaucomatous visual field defects in a stage that is considered acceptable for a timely detection.¹⁷⁻¹⁹ The use of FDT has great advantages over SAP. The low spatial frequency makes FDT rather insensitive to optical blur and the low number of test locations makes the test last only 1 minute in the C-20 screening mode (compared to up to 10 minutes using SAP). The learning effect of FDT is relatively small and an abnormal test result can be confirmed or falsified during the same visit.^{20,21} This repeat test is pivotal to avoid false-positive labeling. In manifest glaucoma, SAP is still considered the gold standard for visual field assessment, but some glaucoma patients fail to deliver reliable visual field test results due to concentration problems or physical restrictions. For these patients, as an alternative to SAP, FDT could offer an opportunity to gain insight in the course of the visual field over time. The suitability for detection of visual field defects in glaucoma suspect patients, however, does not without more imply suitability for the

detection of visual field change in manifest glaucoma. In **chapter 4**, it was shown that longitudinal collection of FDT test results does give valuable information that would otherwise be provided by SAP. On the other hand, SAP showed a better longitudinal signal-to-noise ratio and should not be replaced by FDT in patients who are able to take SAP tests.

Finally, I tried to optimize the visual field testing itself. For patients with moderate to severe glaucoma, perimeters do not use their time efficiently, since blind part of the visual field are being measured in every test. Visual field damage is irreversible, thus it seems logical not to test these parts in future tests. In **chapter 5**, we found that this was possible if test points were tested as having a sensitivity <0 dB (the brightest stimulus was not seen) in 3 consecutive visual field tests. The outcome of the Nonparametric Progression Analysis (NPA) was not influenced by omitting these test points, indicating that it is safe to assume blindness in future tests in these parts of the visual field.

Optimizing Glaucoma Care - Some Critical Remarks

In this thesis, I suggest to reduce the intensity of treatment and/or follow-up in patients that (1) are old enough to remain seeing despite glaucoma progression or (2) show glaucoma progression slow enough not to go blind, given their age and glaucoma stage. Why would I advocate such an apparently liberal approach for these patients?

In the current economic situation, the most obvious answer to this “why” question would be “the costs”. However, in glaucoma, there is something peculiar to the costs of consultations and treatments. In a report by Van Gestel and colleagues, it was calculated that treating all glaucoma patients saves costs, since treating glaucoma prevents blindness and the costs associated with blindness are much higher than the costs of glaucoma care.²² In other words, cost-effectiveness is never an issue in glaucoma care, because in the long run, treating all glaucoma patients is cheaper than accepting blindness in some of them, with all associated costs. Thus, glaucoma care is in the south-east quadrant of the cost-effectiveness plane (*south = less costs, east = more effective*). From this point of view,

optimizing care by omitting unnecessary care turns glaucoma care from cost-effective to even more cost-effective.

A possible point of criticism to an apparently more liberal approach is that it might pose the patient to a greater risk of visual impairment. In a time-trade-off calculation, it was acknowledged that people value their visual functioning highly: the average person with counting fingers vision in the better eye was willing to trade approximately 5 of every 10 remaining years of life in return for perfect vision.²³ This is comparable to the time-trade off after a major cerebrovascular stroke.²⁴ Visual field loss is reported to be related to quality of life.²⁵⁻³⁰ This is more marked in patients with bilateral involvement of the inferior fields and especially in patients with end-stage glaucoma.³⁰ The approach I present however, is designed to prevent end-stage disease and thus, glaucoma related quality of life decrease is avoided. Moreover, it might even relieve the patient from time- and energy-consuming overtreatment, unnecessary consultations and visual field examinations. There might be a few patients that progress faster or live longer than could be expected. Luckily, glaucoma is still a relatively slowly progressive disease and adjustments to therapy can be made if the risk for visual impairment turns out to be unacceptable in later stages.

From Scientific Concepts to the Consulting Room

In practice, glaucoma patients often visit the ophthalmic department ones or twice a year. They have a fairly acceptable IOP and the visual field test is about the same as last years'. In an often overbooked consultation hour, the most obvious and easiest decision is to continue all medication and plan a next visit. Then, this routine repeats itself. In this way, glaucoma care is reduced to a cross-sectional evaluation, rather than a longitudinal evaluation. Slow changes and opportunities to take action are easily missed, with disastrous results in some patients.

I realize that changing a routine is difficult, especially when it seems to take more time and effort to incorporate new ideas or concepts. Applying a new progression analysis or evaluating the risk for blindness at the end of life will take some effort. However, the ideas I present in this thesis were developed keeping in mind the reality of the ophthalmologists consulting room. NPA does not need any software and is easily applied. The graphs presented in chapter 6 are readily available and

only basic information needs to be known to use them (gender, age, and visual field status). Therefore, the investments are minimal and do not counterweigh the gains, being better care and more efficient usage of resources.

In the University Medical Center Groningen a glaucoma-specific electronic patients file is in use, where all data recorded at glaucoma-related visits are collected. These include factors that need to be recorded only once (date of birth, gender, central corneal thickness, type of glaucoma, and more) and factors that change over time, such as IOP, visual field parameters, and medication usage. The program presents the physician with all information that is of interest, including the result of the NPA, the progression velocity, and the expected end-of-life MD. In this way, improving glaucoma care is easy and fast.

For the future, the most ideal situation would be a glaucoma patient file that is integrated in an electronic patient file. All recorded test results are automatically put in a database, including all parameters from functional and structural tests. The program guarantees a longitudinal view of the matter and should alert the physician on all unexpected findings or unacceptable changes. With all this information available, it is the physician's task to place this information in a context of the patient's general health, complaints, wishes, and visual needs. The physician should guide the patient in his or her journey as a glaucoma patient, trying to prevent the patient from impairment in a way that is efficient, effective, and respectful.

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