ORIGINAL ARTICLE

Myopia or Hypermetropia?

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SUMMARY

Introduction: The study describes cases of patients screened for worse vision and headaches. We are trying to point out we can measure minus diopters even at latent hypemetropes. These patients come to a doctor for a variety of problems that may be caused by inadequate correction of ametropia. It is necessary to know about this possibility, and rather perform cycloplegia in sporadic cases.
Methods: Patients were measured at autorefractometer without mydriasis, and then after using UNITROPIC 1% or CYCLOGYL 1%. Both of these substances induce cycloplegia. Visual acuity with the best correction was tested with and without cycloplegia.
Results: After cycloplegia, a significant change in both objective and subjective refraction was detected in most of the selected patients. This change was within the meaning of a shift to hyperopia. Subsequent adjustment correction led to resolving of problems.
Conclusion: The work should highlight the necessity of an individual approach of prescription of the best correction. Not always an autorefractometer gives correct information, the real-needed correction is completely different in some cases.

Key words: myopia, hyperopia, cycloplegia, spectacle correction

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INTRODUCTION

In our work at the general eye outpatient clinic, we encounter patients who come to us with various conditions. Some of them (poor distance vision, poor near vision, headache) can be caused by inadequate correction of ametropia, in certain cases also with subsequent excessive strain on the accommodating apparatus of the eye. It is necessary to consider this possibility and in sporadic cases rather to conduct an examination in cycloplegia.

Theory

According to the relationship of the focal spot to the retina we differentiate two spherical ametropias: myopia and hypermetropia (hyperopia).
Myopia (short-sightedness) – the focal point of the non-accommodated eye lies in front of the retina. As a rule it is caused by excessive growth of the eye (normal length approximately 24 mm, difference of 1 mm corresponds to approximately 3 dioptres). In these patients we use the weakest correction with which the patient can read the smallest value of the optotype from the prescribed distance. Although overcorrection would cause the patient to see with perfect sharpness, it would be necessary for the patient to engage accommodation upon distance vision, and this increased accommodating exertion would lead to complaints such as headaches or migraines, fatigue etc. (11).
Hypermetropia (long-sightedness) – the focal spot of the non-accommodated eye lies behind the retina. A part of total hypermetropia is compensated for by the individual permanent tone of the ciliary muscle – here we are referring to latent hypermetropia. The remaining part is termed manifest hypermetropia. This may have two components – facultative and absolute hypermetropia. Absolute hypermetropia is no longer corrected in any way by the eye, and is thus manifested in a reduction of vision. Facultative hypermetropia can be corrected by an increased accommodating exertion, which may cause asthenopic complaints. Absolute hypermetropia, i.e. latent plus manifest component, can be determined only after complete elimination of the accommodating apparatus of the eye, in cycloplegia (11).
At present there is a range of substances on the market which we can use for cycloplegia (13). However, there is no clear consensus as to which substance is optimal in order to attain cyclopledia for the purposes of examination of refraction (1, 2, 6, 7, 8, 12, 13, 15). Amongst the most frequently used are tropicamide, cyclophenolate, atropine, homatropine, also used is phenylephrine, or a combination of these substances (1, 2, 4, 7, 12, 13). Cycloplegic refraction is important in order to detect refractive errors, primarily in children (6, 15). However, its significance in adults is underestimated. Inadequate cycloplegia can lead to an overestimation of myopia or an underestimation of hypermetropia (6, 14).

RESULTS

In our practice we relatively frequently encounter patients whose complaints in some way do not correspond with other circumstances such as age, and often the value of the dioptres examined by autorefractometer. Young patients aged around 20-30 years with myopic refraction determined by autorefractometer complain of deteriorated near vision, headaches during work on computer and epiphora. They also state poor distance vision. However, this is not as deteriorated as it may seem according to the results of the autorefractormeter, and myopic correction does not have the expected effect. Some of them are even sent from the neurology department due to cephalea in order to eliminate congestion papilla in intra-cranial hypertension.

Patients were measured on a SPEEDY-K autorefractometer produced by the Nikon company, first without mydriasis, subsequently in mydriasis created with the help of tropicamide (UNITROPIC 1%, UNIMED PHARMA s.r.o., Bratislava, Slovakia) or cyclophenolate (CYCLOGYL 1%, Alcon Laboratories, Puurs, Belgium). Both of these substances induce cycloplegia. Best corrected visual acuity was examined both naturally and in cycloplegia.
We present several examples here. In all there was an objectively physiological ocular finding.

Patient 1 (female), 28 years old

For approximately six months subjectively states worse distance vision. Visual acuity values VRE: 0.2 naturally, s -1.25 = 1.0, VLE: 0.3 naturally, s -0.75 = 1.0, near vision in both eyes J no. 1 naturally and with correction. Result of measurement by autorefractometer naturally RE: -2.25 = -0.25ax.2, LE: -1.5 = -0.25ax.162. Following the examination myopia modica bilaterally was diagnosed, glasses were prescribed RE: -1.0, LE: -0.5. With this correction visual acuity was 1.0.
The patient came for the next check two months later due to the following complaints: she sees worse to distance with the new glasses, and suffers headaches during longer periods of reading. The values of vision were surprising. VRE: 0.2 naturally, correction not improved, VLE: 0.3 naturally, s 0.75 = 1.0. The results of the subsequent examination in mydriasis (tropicamide) were unexpected. The values measured by auto refractometer showed RE: +0.5 = +0.25ax.90, LE: +0.25 = -0.25ax.5. The diagnosis was therefore amended to latent bilateral hypermetropia. The patient obtained new glasses with +0.5 dioptre and was instructed of the necessity of gradual acclimatisation to them, initially mainly during work close up. At a check-up after six months she is satisfied with the correction.

Patient 2 (female), 20 years old

Subjectively eyes are often fatigued, focuses poorly, wears contact lenses received from optician, right -0.5m, left -0.75. The patient would like glasses for driving a motor vehicle. Vision RE: 0.8 naturally, s -0.75 = 0.9, LE: 0.9 naturally, s -0.5ax.155 = 1.0 partially. Result of autorefractometer: naturally RE: -0.75 = -0.25ax.33, LE: +0.0 = -0.5ax.157. With regard to the uncharacteristic complaints ("suspiciously" good natural vision on these myopic dioptres, correction does not improve as we are generally accustomed to for myopics), an examination was conducted in cycloplegia (tropicamide), in which refraction was determined RE: +1.25 = +0.25ax.114, LE: +1.75 = +0.5ax.76, value of vision V: 0.8 naturally, s +0.75 = 1.0. Latent bilateral hypermetropia was diagnosed. Following instruction the patient received prescribed glasses +0.5. After six months she states that she wears them for close up work, she is satisfied and the complaints have subsided.

Patient 3 (male), 26 years old

Subjectively states asthenopic complaints, epiphora and cephalea. Vision V: 1.0 naturally, J. no. 1 naturally, refraction determined by autorefractometer RE: -0.5, LE: -0.5 = -0.25ax.24. Due to the uncharacteristic complaints (asthenopic complaints in a young person and myopia according to autorefractometer) an examination was conducted in cycloplegia (cyclophenolate). Subsequently the values on the autorefractometer showed RE: +0.75, LE: +0.75 = +0.25ax.112, V: 0.8 naturally, s +0.75 = 1.0. Latent bilateral hypermetropia was again diagnosed. We recommended glasses RLE +0.5 dioptre. Six months later the patient states that he does not wear the glasses for distance vision, but feels relief with glasses when working at computer or reading, complaints with epiphora and headaches have subsided, patient is satisfied.

Patient 4 (male), 34 years old

Sent from neurology department due to cephalea in order to eliminate intra-cranial hypertension. Subjectively states headaches in the area of the temples early morning and afternoon. Neurological finding is within the norm. V: 1.0 naturally, J no. 1 naturally, dioptre measured by autorefractometer naturally RE: -1.5, LE: -2.0. We subsequently conducted an examination in cycloplegia (cyclophenolate), in which the result of the autorefractometer was RE: +1.75, LE: +1.75 = +0.25ax.158, V: s + 1.5 = 1.0. Additionally states in anamnesis that he was examined at an eye department at the age of 4 and instructed to wear glasses but refused them. In our examination congestion papilla was excluded and latent bilateral hypermetropia was diagnosed. Glasses +0.75 dioptre were prescribed. Six months later the patient states that the complaints have ceased. The patient is still being monitored and an increase of correction is planned for the future.

DISCUSSION

As is evident from fig. 1 (5), in myopia with refraction = 1.0 dioptre, the value of natural vision is around 0.3. In addition, in such myopic patients we expect a "wow" effect after applying adequate correction. If the patient had a different condition, for example the values of vision are unexpectedly good with regard to the dioptres, it is necessary to consider this and preferably perform cycloplegia.
In his article "Glasses – a simple matter", Boháč recommends that even for patients who have attained a vision of 1.0 it is advisable try whether the patients can tolerate +0.5 Dsf mononuclear, and in the case that they do not state worse vision, it is possible

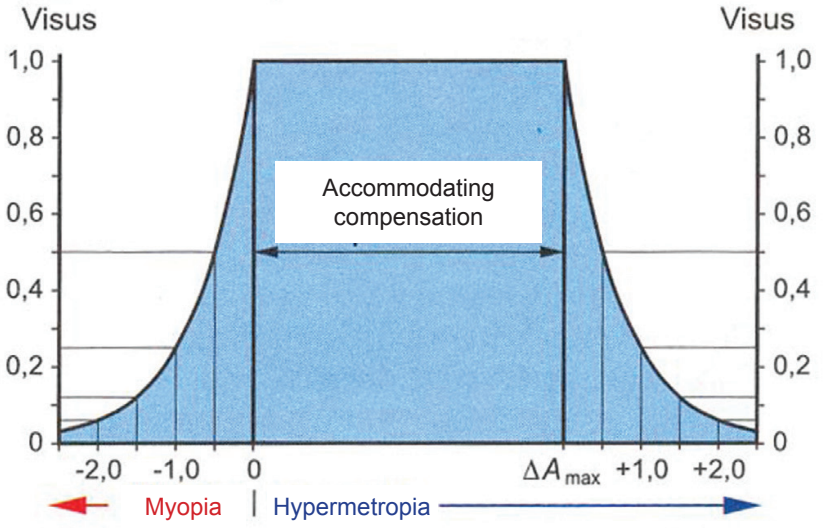

Fig. 1. Author: Diepes, H

to infer the possibility of latent hypermetropia. A second possibility is the performance of the "fogging method" (author professor Sachsenweger). During this we examine each eye separately, placing +2.0D into the glasses frame and allowing the patient to look at an optotype for several minutes. We progressively reduce the values by +0.5D. If we determine that the patient reads better with +1.0 (patients sometimes state that the letters are blacker), this mostly concerns latent hypermetropia (3). In regular practice, however, we are often limited by time. Patients frequently state that their vision is worse even with only weak hyperopic correction upon first view of the optotype. We then obtain the opposite result in cycloplegia. Jones speaks of psychological pseudomyopia. Measurement of objective refraction demonstrates that accommodation is not entirely disengaged even when the stimulus to refraction is zero. He termed this myopic shift psychological pseudomyopia (10). In our opinion this matter also can influence examination on an autorefractometer without the use of cycloplegia, nevertheless this cannot represent the sole fact. If this were the case, hyperopic correction should improve vision even naturally. However, we do not encounter this in these uncharacteristic patients.

In children the difference between manifest refraction and refraction in cycloplegia is generally known. This has been dealt with for example by Rotsos, who in his work compared these parameters in 69 true myopic and 73 emmetropic and hyperopic eyes. He determined that in the case of a negative spherical value of the dioptres, its strength was far higher naturally than in cycloplegia and vice versa (14).

Opinions vary on how many drops to apply and at what intervals in order to attain cycloplegia. Bhatia works with one drop of 1% tropicamide or 2% homatropine with measurement of refraction after 45 minutes (tropicamide) or 60 minutes (homatropine) (2). Bagheri compared the difference between the effect of one, two and three drops of 1% cyclophenolate. He did not demonstrate a statistically significant difference between the groups (1). By contrast, Mohan compared the effect of 1% cyclophenolate applied once, twice and three times in 51 hyperopic patients. According to his work, there is a statistically significant difference between the application of one and three drops, whilst the difference between the application of two and three drops is no longer statistically significant, from which he concludes that the application of 1% cyclophenolate twice within a ten minute interval is sufficient (12). Fotouhi uses two drops of 1% cyclophenolate at a 5 minute interval, with subsequent measurement of refraction 25 minutes after the second drop (7).

Tropicamide was used until recently in our workplace, now we have cyclophenolate available. Tropicamide is a blocker of the acetylcholine receptors, which has a short term cycloplegic and mydriatic effect (2). Cyclophenolate is a synthetic anticholinergic substance, an antagonist of the muscarine receptors (4). We apply tropicamide twice within an interval of ten minutes with subsequent measurement of refraction twenty minutes after the last drop, cyclophenolate twice within an interval of ten minutes with subsequent measurement of refraction thirty minutes after the second drop. We do not have statistically processed results due to the relatively small number of patients, in the majority of cases however the difference between cycloplegic refraction attained using tropicamide and cyclophenolate is slightly in favour of the latter substance.

The difference between the effect of tropicamide and cyclophenolate was compared by Hofmeister et al. in their study on 30 myopic patients before a refractive procedure (average age 35.4 years). There was not a statistically significant difference between cycloplegic reaction after the application of tropicamide and cyclophenolate. In three eyes of five patients the difference in refraction was 0.5D and higher, the smaller myopia was after instillation of cyclophenolate. Upon testing of refraction to near vision a smaller residual accommodation was determined upon use of cyclophenolate. The great majority of patients preferred tropicamide (8).

The effect of 1% tropicamide in 76 eyes and 2% homatropine in 28 eyes is compared by Bhatia in his work, with the results evaluated using an a-scan. The average reduction in the thickness of the lens after application of tropicamide was 0.21 mm (from an original thickness of 3.92. SD 0.34), after application of homatropine the width of the lens was reduced on average by 0.24 mm (from an original 3.87, SD 0.29). Both of these differences are statistically significant. Flattening of the lens occurred as a consequence of cycloplegia (2).

The validity of non-cycloplegic refraction was the subject of the Tehran study (Fotouhi). Measurement was conducted on 3501 persons aged over 5 years, in all of whom refraction was measured without and in cycloplegia (2 drops of 1% cylcophenolate applied at an interval of 5 minutes, measurement of refraction 25 minutes after the second application). Fotouhi found that sensitivity of non-cycloplegic myopia was 99%, whereas specificity is only 80.4%. By contrast, sensitivity in hypermetropia was only 46.9%, but specificity 99.4%. In all age categories, non-cycloplegic refraction overestimated myopia and underestimated hypermetropia. Overestimation of myopia was greatest in the age groups of 21-30 years and 31-40 years. Underestimation of hypermetropia was greatest in the group aged under 50 years, declining by 8% to the age of 70 years (0%). From this Fotouhi concludes that errors may have occurred in the case of measurement of non-cycloplegic refraction, except the group of patients aged 50-60 years (7). Our experience also corresponds to these results, in which virtually all patients examined in cycloplegia due to uncharacteristic complaints belong in the category of 21-40 years.

The necessity of performing cycloplegia up to the age of 45 years is emphasised by the work of the French author Jeddi. In this prospective study, together with his colleagues he examined 164 eyes of 82 patients suffering from headaches. In cycloplegia (cyclophenolate), hypermetropia was significantly the most frequent ametropia. After examination full correction was applied to the patients, eliminating headaches in 76.5% of cases (9). In our workplace we do not apply full correction immediately, according to our experience this correlation can transitionally diminish distance vision, a better procedure seems to us to be progressive increase of dioptres and gradual acclimatisation, in most cases initially upon work close up.

The importance of examination of refraction in cycloplegia is mentioned also by the work of the author Ebri, who compared the effectiveness of three different cycloplegic drugs (1% cyclophenolate, 1% cyclophenolate + 0.5% tropicamide, 1% atropine) on Nigerian children. The main aim was to determine residual accommodation. Significantly the lowest residual accommodation was after administra-

tion of atropine, followed by a combination of 1% cyclophenolate + 0.5% tropicamide and then cyclophenolate alone (6). It is certainly appropriate in a range of cases to know which cycloplegic drug works best, though for regular practice the minor differences between them are not fundamental. As we have already stated, we do not apply full correction immediately, we always begin to accustom patients first of all to the values of +0.5 to +0.75 dioptre. For this reason it is not necessary to know the refraction "precisely to quarters of the dioptre". In addition, it seems inappropriate to us to burden adult patients in productive age with atropine (outside of therapeutic use).

CONCLUSION

Examination of refraction in cycloplegia before prescribing spectacle correction is not a regular necessity for adult patients. The majority of myopias are true myopias, and this applies also to hypermetropias. However, it is necessary to consider this possibility, and in the case of discrepancies rather conduct an examination. We also encounter cases in which we would expect potential latent hypermetropia, but it is not demonstrated in cycloplegia. It is however better to confirm that this is a genuine case of myopia than to prescribe inappropriate spectacle correction. In our experience it is then appropriate to correct these patients progressively, and if they are sufficiently instructed they will not invest unnecessarily large amounts in the first pair of glasses, after which subsequent strengthening is only of benefit.

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