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Intraoperative floppy iris syndrome – epidemiology and clinical assessment

Zespół śródoperacyjnie wiotkiej tęczówki – ocena epidemiologiczno-kliniczna

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Abstract:

Purpose: To assess the incidence, and to identify medications and clinical features associated with intraoperative floppy iris syndrome in patients undergoing cataract surgery.

Material and methods: The non-randomized, observational, prospective study was performed in 616 eyes (610 patients) after cataract surgery to determine the incidence of intraoperative floppy iris syndrome and the medications associated with its higher prevalence. We used a slit lamp adapted optical coherence tomography to evaluate anterior segment of 155 eyes (154 patients), measuring pupil diameter before and after the use of mydriatics and assessing the pre-dilated iris thickness at the dilator and sphincter muscle region.

Results: The overall incidence of intraoperative floppy iris syndrome was 4% (25/616 eyes). The highest prevalence of intraoperative floppy iris syndrome was shown in patients exposed to tamsulosin (39%). Pupil diameter in mm before and after mydriasis was significantly smaller in patients with intraoperative floppy iris syndrome as compared to the syndrome-free ones (pre-dilated – 1.85 ± 0.43 vs. 2.16 ± 0.37; $p < 0.01$; dilated – 5.04 ± 1.01 vs. 5.70 ± 0.87; $p < 0.01$). The thickness of the iris in sphincter muscle region in μm was similar in patients with and without intraoperative floppy iris syndrome (520.3 ± 76.1 vs. 520.6 ± 72.4; $p > 0.05$). Significantly thinner iris in dilator muscle region was found in patients with intraoperative floppy iris syndrome as compared to the syndrome-free ones (409.9 ± 55.7 vs. 448.6 ± 55.8; $p < 0.05$). The presence of intraoperative floppy iris syndrome was correlated with a higher risk of intraoperative complications.

Conclusions: Patients with intraoperative floppy iris syndrome have decreased pupil diameter and a thinner iris in dilator muscle region. Slit lamp optical coherence tomography is a useful device to preoperatively detect clinical features associated with intraoperative floppy iris syndrome. These findings may warn the surgeon of potential intra-operative difficulties.

Key words: intraoperative floppy iris syndrome (IFIS), epidemiology, cataract surgery, slit lamp optical coherence tomography (sl-OCT).

Abstrakt:

Cel: ocena częstości występowania zespołu śródoperacyjnej wiotkiej tęczówki u pacjentów operowanych z powodu zaćmy oraz określenie, jak przyjmowane przez pacjentów leki wpływają na występowanie tego schorzenia i jakie są cechy kliniczne związane z jego występowaniem.

Materiał i metody: nierandomizowane, obserwacyjne, prospektywne badanie 616 oczu (610 pacjentów) operowanych z powodu zaćmy przeprowadzono w celu oceny częstości występowania zespołu śródoperacyjnie wiotkiej tęczówki oraz wpływu na tę częstość leków stosowanych przez pacjentów. Za pomocą optycznej koherentnej tomografii służącej badaniu przedniego odcinka oka przebadano 155 oczu (154 pacjentów) przed zastosowaniem mydriatyków i po ich zastosowaniu – dokonano pomiarów szerokości źrenic oraz grubości tęczówek w obrębie rozwieracza źrenicy oraz w obrębie zwieracza źrenicy.

Wyniki: częstość występowania zespołu śródoperacyjnie wiotkiej tęczówki wyrażonego jako obecność pełnej triady charakterystycznych objawów śródoperacyjnych oszacowano na 4% (25/616 oczu). Największy, 39-procentowy, odsetek występowania zespołu śródoperacyjnie wiotkiej tęczówki odnotowano u pacjentów stosujących tamsulozynę. Szerokość źrenicy (mm) przed zastosowaniem mydriatyków i po ich zastosowaniu była istotnie mniejsza u pacjentów z zespołem śródoperacyjnie wiotkiej tęczówki niż u badanych, u których tego zespołu nie zdiagnozowano ($1,85 \pm 0,43$ vs. $2,16 \pm 0,37$; $p < 0,01$; mydriaza: $5,04 \pm 1,01$ vs. $5,70 \pm 0,87$; $p < 0,01$). Grubość tęczówki (μm) w obrębie zwieracza źrenicy była porównywalna i wynosiła odpowiednio: $520,3 \pm 76,1$ vs. $520,6 \pm 72,4$; $p > 0,05$. Istotnie cieńszą tęczówkę w obrębie rozwieracza źrenicy odnotowano u badanych z zespołem śródoperacyjnie wiotkiej tęczówki, zmierzone wartości wynosiły odpowiednio: $409,9 \pm 55,7$ vs. $448,6 \pm 55,8$; $p < 0,05$. Wystąpienie zespołu śródoperacyjnie wiotkiej tęczówki korelowało ze zwiększonym ryzykiem powikłań operacyjnych.

Wnioski: u badanych z zespołem śródoperacyjnie wiotkiej tęczówki szerokość źrenicy oraz grubość tęczówki w obrębie rozwieracza źrenicy są zmniejszone. Badanie sl-OCT jest użytecznym narzędziem do przedoperacyjnego wykrywania cech klinicznych związanych z zespołem śródoperacyjnie wiotkiej tęczówki. Wyniki badania optycznej koherentnej tomografii mogą ostrzec chirurga o możliwości wystąpienia trudności operacyjnych związanych z zespołem śródoperacyjnie wiotkiej tęczówki.

Słowa kluczowe: zespół śródoperacyjnie wiotkiej tęczówki (IFIS), epidemiologia, operacja zaćmy, optyczna koherentna tomografia skojarzona z lampą szczelinową (sl-OCT).

Introduction

In 2005 Chang and Campbell (1) described a new condition affecting the iris and observed during cataract surgery. They named it intraoperative floppy iris syndrome (IFIS) and characterized it as a triad of intraoperative features: the flaccid iris stroma that undulates and billows in response to physiological intraocular fluid flow; a propensity for the floppy iris stroma to prolapse towards the phaco and side port incisions, despite proper wound construction, and the progressive intra-operative pupillary constriction. Although IFIS has become a commonly known and well documented complication of cataract surgery, the precise pathomechanism has not been completely explained.

Initially, the presence of IFIS was known to be associated with administration of a selective α1-adrenergic receptor antagonist – tamsulosin. This drug was widely prescribed to elderly males for symptomatic treatment of benign prostatic hypertrophy (1). Since the first publication, many authors have observed typical intraoperative features also in patients using hypertensive, antipsychotic and neuroprotective drugs, including non-selective α1-adrenergic receptor antagonists (2–9).

The development of modern imaging techniques, such as slit lamp adapted optical coherence tomography (sl-OCT), enabled fast and non-contact acquisition of objective cross-sectional images of the anterior segment, including iris structure. Using sl-OCT in cataract patients may help determine a potential causal mechanism of IFIS.

Material and methods

We performed a non-randomized, observational, prospective study in 610 consecutive patients (191 males and 419 females; 616 eyes), who underwent cataract phacoemulsification in our department. Exclusion criteria were: history of ocular trauma, uveitis, previous intraocular surgery and any other condition which may have influenced iris morphology. Medical history including the list of current and past medications (especially drugs associated with IFIS: used for treating benign prostatic hypertrophy or hypertension with 1 adrenolytic activity) was taken on admission.

Out of 610 enrolled patients (616 eyes), 590 (596 eyes) were examined preoperatively using the sl-OCT (Heidelberg Engineering). The remaining 20 patients were not examined with sl-OCT due to technical and logistical reasons.

To assess iris structure, we evaluated sl-OCT images post-operatively in 3 groups of patients: 23 patients (23 eyes) with IFIS (full triad of symptoms), 41 patients (42 eyes) with incomplete IFIS and a control group of 90 randomly chosen patients (90 eyes) without IFIS. For all sl-OCT examinations constant lightning conditions and device settings were ensured, and a 1 mm slit lamp light beam set at maximum intensity to obtain 4 high quality horizontal cross-sectional images of the anterior segment of the eye was used. We measured pupil diameter before and after the use of mydriatic agents (1% tropicamide, 10% phenylephrine), the pre-dilated iris thickness at the dilator muscle region (DMR – half of the distance between the scleral spur and pupillary margin) and at the sphincter muscle region (SMR – 0.75 mm from the pupillary margin). To neutralize the effect of iris crypts on iris thickness, 3 pre-dilated images were measured and the results were averaged.

All patients underwent phacoemulsification cataract surgery with posterior chamber acrylic, foldable intraocular lens implantation performed by 4 experienced surgeons. Directly after procedure, the patients were assessed for the presence of IFIS features and intraoperative complications. The IFIS was defined by the unmasked surgeon as the presence of full triad of signs described by Chang and Campbell (1). The follow-up slit lamp assessment of anterior and posterior segment (using Volk lens) was performed on day 1., week 1. and month 1. postoperatively.

Non-parametric tests were used for the statistical analysis. To determine the relationship between qualitative variables in study groups, we used a chi-square independence test and to compare the means of quantitative variables, we used Mann-Whitney test. All calculations were performed assuming the significance level $\alpha = .05$. P value below .05 was considered statistically significant.

Results

16.9% of patients had a positive history for current or past use of IFIS-related medications (103/610 patients; 75 males; 28 females). The overall incidence of IFIS, defined as the presence of full triad of characteristic intraoperative features, was 4.0% (25/616 eyes; 19 males and 6 females). Twenty-one of those 25 patients used IFIS-related medications (18 males; 3 females), whilst 4 of them did not (1 male; 3 females). The highest prevalence of IFIS was observed in patients exposed to tamsulosin (39%). In other medications the prevalence of IFIS was: finasteride 26%; alfuzosin 20%; doxazosin 18% and carvedilol 12% (Fig. 1). IFIS occurred more often in patients exposed to tamsulosin than carvedilol ($Chi^2 = 5.960$; $p < .05$). Differences between patient subgroups using other medications were not statistically significant. None of patients from our cohort using antipsychotic and neuroprotective medications developed IFIS.

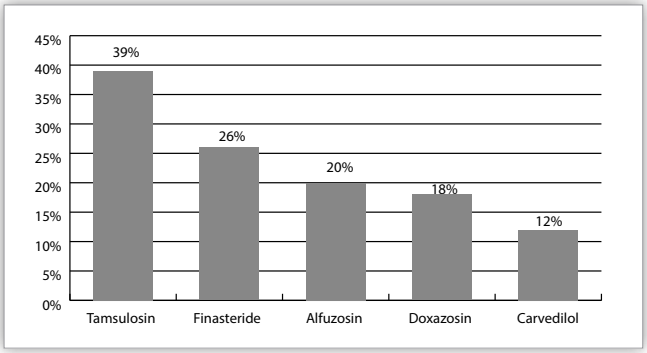

Fig. 1. Prevalence of IFIS in patients using various medications.
Ryc. 1. Częstość występowania IFIS u pacjentów stosujących różne leki.

Pupil diameter (in mm), before and after the use of mydriatic agents was significantly smaller in patients with IFIS versus patients without IFIS (pre-dilated: 1.85 ± 0.43 vs. 2.16 ± 0.37; $p < .01$; dilated: 5.04 ± 1.01 vs. 5.70 ± 0.87; $p < .01$) (Fig. 2). The thickness of the iris in sphincter muscle region (SMR) in μm was similar in patients with and without IFIS (520.3 ± 76.1 vs. 520.6 ± 72.4; $p > .05$) (Fig. 3). Iris thickness in dilator muscle region (DMR) was significantly lower

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in patients with IFIS than in patients without IFIS (409.9 ± 55.7 vs. 448.6 ± 55.8; $p < .05$) (Fig. 4, 5). There were no statistically significant differences in values of SMR and DMR between patients with incomplete IFIS and without IFIS (properly SMR: 537.1 ± 67.7 vs. 520.6 ± 72.4; $p > .05$; DMR: 438.0 ± 61.3 vs. 448.6 ± 55.8; $p > .05$). The presence of IFIS was correlated a with higher risk of perioperative complications ($Chi^2 = 4.992$; $p < .05$). Among patients with IFIS, 52% developed focal iris laceration, 20% presented with iris sphincter injury, whereas transient postoperative hypertension and posterior capsule rupture occurred in 16% and 8%, respectively.

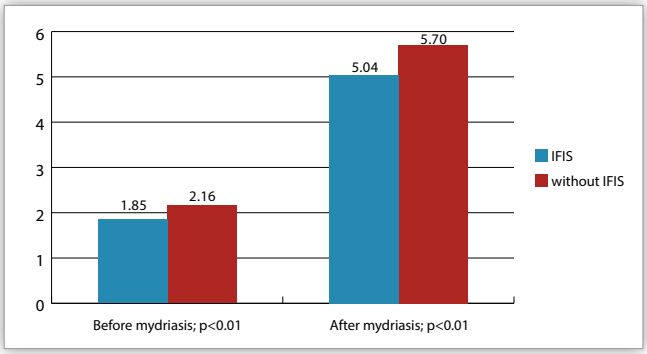

Fig. 2. Pupil diameter (mm) before and after mydriasis in sl-OCT.
Ryc. 2. Szerokość źrenicy (mm) przed zastosowaniem mydriatyków i po ich zastosowaniu zmierzona w badaniu sl-OCT.

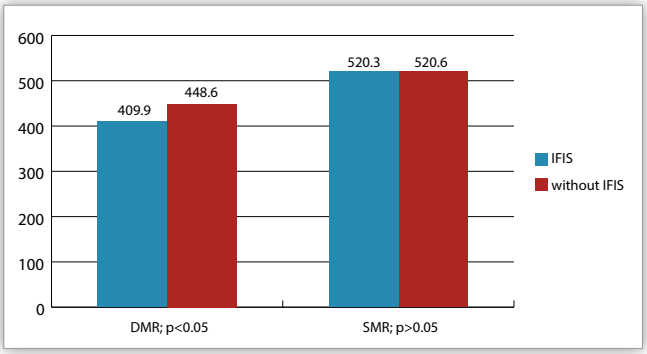

Fig. 3. Iris thickness (μm) in sl-OCT.
Ryc. 3. Grubość tęczówki (μm) zmierzona w badaniu sl-OCT.

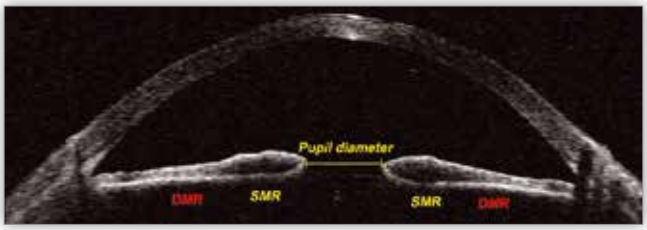

Fig. 4. Example of pre-dilation sl-OCT image of a patient with IFIS.
Ryc. 4. Przykładowy wynik badania sl-OCT u pacjenta z IFIS.

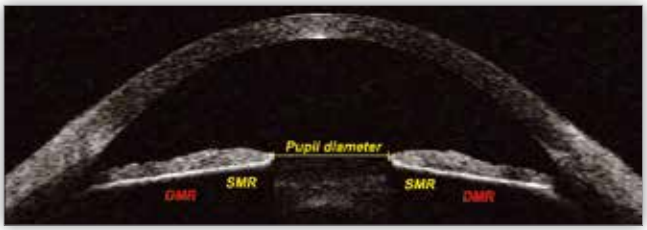

Fig. 5. Example of pre-dilation sl-OCT image of a patient without IFIS.
Ryc. 5. Przykładowy wynik badania sl-OCT u pacjenta, u którego nie zdiagnozowano IFIS.

Discussion

The intraoperative floppy iris syndrome remains an interesting problem for ophthalmologists, while its etiology and pathomechanism have not been not fully explained.

In our study, IFIS occurred in both male and female cataract patients, being most frequently associated with using α1-adrenergic receptor antagonists. Our study confirms the etiology of IFIS described by other authors (5, 8–10). The presence of IFIS increased the risk of intra-operative complications, which is in line with several publications (8, 10, 11).

Neff et al. (5) assessed factors associated with the presence of IFIS. Their analysis showed IFIS in 33 eyes (3.7%) of 27 patients (4.1%). Tamsulosin use and history of using other α1-antagonists were shown to strongly correlate with IFIS. The authors also noted that systemic hypertension was significantly implicated in IFIS etiology.

In their metaanalysis, Chatziralli i Sergentanis (9) confirmed a correlation between IFIS and use of α1-antagonists with the leading role of tamsulosin as a causal factor. The use of tamsulosin was associated with approximately 16-fold greater risk of IFIS than the use of alfuzosin. The intraoperative floppy iris syndrome was positively correlated with hypertension, but not with diabetes mellitus.

Vollman et al. (10) proved that the use of either selective or non-selective α-antagonists preoperatively significantly increased a risk of IFIS during cataract surgery. Their study demonstrated statistically significant higher odds of surgical complications, such as: intraoperative iris trauma, intraoperative iris prolapse, posterior capsular tear, anterior capsule tear, intraoperative vitreous prolapse, and need of pupillary expansion devices in patients with IFIS vs those without IFIS.

A limited number of authors examined the effect of IFIS-correlated medications on iris structure. Results of their studies are not identical. Prata et al. (12) used sl-OCT to identify IFIS-related structural alterations of the iris in patients treated with systemic α1-adrenergic receptor antagonists. They found significantly lower DMR thickness and smaller photopic pupil diameter in those patients with no difference in SMR thickness. Those relations were confirmed in our study. By contrast, Tufan et al. (13) preformed sl-OCT examinations to find no structural alterations of the iris. SMR and DMR thickness were similar in patients using systemic α1-adrenergic receptor antagonists and in the control group. Only a photopic pupil diameter was significantly reduced in the study group.

In histologic examinations of cadaver eyes, Santaella et al. (14) found patients treated with tamsulosin to have decreased iris dilator muscle thickness in comparison with patients from the control group. The authors observed no difference in iris stromal thickness within the groups. No direct relationship between the duration of tamsulosin use and iris dilator muscle thickness or stromal thickness was found.

Conclusions

Patients treated for benign prostatic hypertrophy or hypertension may have an increased risk of complications during cataract surgery due to IFIS. Patients with IFIS have a significantly thinner iris in dilator muscle region and decreased pupil diameter. Slit lamp adapted Optical Coherent Tomography sl-OCT

is a useful device which enables detection of clinical features associated with IFIS preoperatively. These findings may warn the surgeon of potential intra-operative difficulties resulting from IFIS.

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