Original article

Screening for ophthalmic disease in the diabetic patient: Eye fundus examination by non-mydriatic retinography with or without examination of visual acuity and intraocular pressure

M.J. Sender, M. Vernet, M. Asaad

Medicina de Familia, Centro de Atención Primaria Terrassa Nord, Consorci Sanitari de Terrassa, Terrassa, Spain
Servicio de Oftalmología, Consorci Sanitari de Terrassa, Terrassa, Spain

A R T I C L E   I N F O

Article history:
Received 21 May 2012
Accepted 2 September 2012
Available online 21 October 2012

Keywords:
Diagnosis
Diabetic retinopathy
Visual acuity
Intraocular pressure
Diabetes

A B S T R A C T

Objective: To screen for eye disease in diabetic patients by performing only an eye fundus examination with non-mydriatic retinography, or a more extensive ophthalmological examination including visual acuity (VA) and ocular tonometry.

Materials and methods: Design: A cross-sectional multicentre study with cohort comparison. Subjects: Diabetic patients who attended 6 Primary Health Care Centres (PCC). Interventions: complete ophthalmological examination of patients in 3 PCC: VA examination, intraocular pressure (IOP) measurement and eye fundus examination with non-mydriatic retinography (egphNMC). Partial examination of patients of the other 3 PCC: only an eye fundus examination with non-mydriatic retinography. Patients with a suspicion of eye disease were referred to the Ophthalmology Department.

Results: A complete ophthalmological examination was carried out on 938 patients (71%) and a partial examination in 383 (29%). Diagnosis: a) suspicion of diabetic retinopathy (DR): 123 cases (9.3%), with no differences between the complete examination (9.1%) and partial examination (9.3%); b) suspicion of glaucoma: 89 cases (8.1%) in complete examination and 3.4% in partial (suspicion due to papillary alteration in egphNMC); c) VA changes: 169 cases (18%) in complete examination. Referral to ophthalmology service was made in 41% of patients with complete examination and 38% in patients with partial examination.

Conclusions: Using only back of the eye examination with a non-mydriatic camera, a high percentage of diabetic patients were not diagnosed with an eye disease distinct to diabetic retinopathy (VA and IOP alterations), which are probably associated to a higher percentage of cataracts and glaucoma in this group.

© 2012 Sociedad Española de Oftalmología. Published by Elsevier España, S.L. All rights reserved.

Please cite this article as: Sender MJ, Vernet M, Asaad M. Cribado de la enfermedad oftalmológica del paciente diabético: exploración del fondo de ojo con retinografía no mióptrica complementada o no con exploración de agudeza visual y presión intraocular. Arch Soc Esp Oftalmol. 2013;88:261–265.

This paper was partially presented at the XXXII Congress of the Family and Community Medicine Society of Spain in Bilbao, June 13–15, 2012.

Corresponding author.
E-mail address: mjsender@cst.cat (M.J. Sender).

2173-5794/$ – see front matter © 2012 Sociedad Española de Oftalmología. Published by Elsevier España, S.L. All rights reserved.
Cribado de la enfermedad oftalmológica del paciente diabético: exploración del fondo de ojo con retinografía no midriática complementada o no con exploración de agudeza visual y presión intraocular

RESUMEN

Objetivo: Determinar las afecciones oculares de los pacientes diabéticos según se realice exclusivamente exploración del fondo de ojo con retinografía no midriática o exploración ampliada con agudeza visual (AV) y tonometría.

Material y métodos: Diseño: estudio multicéntrico transversal con comparación de cohortes. Sujetos: Pacientes diabéticos atendidos en seis centros de Atención Primaria de Salud (APS). Intervenciones: a los pacientes de tres de los centros se les realizó una exploración oftalmológica completa: determinación de AV, determinación de presión intraocular (PIO) y fotografía de fondo de ojo con cámara de retina no midriática (FfoCNM). A los pacientes de los otros tres centros se les realizó únicamente la FfoCNM (exploración parcial). Derivación al Servicio de Oftalmología de los pacientes con sospecha diagnóstica de enfermedad.

Resultados: Se realizó exploración oftalmológica completa en 938 pacientes (71%) y parcial en 383 (29%). Diagnósticos: a) sospecha de retinopatía diabética (RD): 123 casos (9,3%) sin diferencias entre exploración completa (9,1%) y parcial (9,3%); b) sospecha de glaucoma: 89 casos (8,1% en la exploración completa y 3,4% en la parcial [sospecha por alteración papilar en FfoCNM]); c) alteración de AV. 169 casos (18%) en la exploración completa. Derivación a la atención especializada del 41% de pacientes con exploración completa y del 18% de pacientes con exploración parcial. Conclusiones: Con la exploración exclusiva de fondo de ojo, con retinografía no midriática, se dejan de diagnosticar un elevado porcentaje de pacientes diabéticos con afección ocular distinta de la RD (alteraciones de AV y PIO) probablemente asociada a mayor prevalencia de cataratas y glaucoma en esta población.

© 2012 Sociedad Española de Oftalmología. Publicado por Elsevier España, S.L. Todos los derechos reservados.

Introduction

The diabetic population frequently experiences ocular involvement in the evolution of the disease, and this involvement goes beyond diabetic retinopathy (DR). Standard ophthalmological screening consists in ocular fundus exploration. However, the higher prevalence of cataracts and glaucoma in this population make it advisable to carry out an expanded ophthalmological examination in order to identify visual acuity (VA) and intraocular pressure (IOP) alterations.1-4

At present, Primary Health Care (PHC) is in charge of checking and following up diabetic patients. Coordination among the professionals who attend diabetic patient complications can improve the attention they provide and optimize referrals to other healthcare levels.

In our environment, in 1997 DR screening was established with non-mydriatic retinal camera.2 In January 2010 a Screening Unit for Ocular Pathologies of Diabetic Patients was established. This multidisciplinary unit comprises ophthalmologists, trained PHC physicians, optometric technicians and customer care staff. This unit coordinates the exploration and follow-up of the diabetic population.

However, due to different organizational structures of health services, in some PHC centers it is possible to carry out an expanded ophthalmological examination including VA and IOP assessments, while in others it is possible only to take ocular fundus photographs.

The objective of the present study is to determine the ocular conditions detected in diabetic patients on the basis of ocular fundus examination only or expanded ophthalmological assessments with VA and tonometry.

Subjects, materials and methods

Design

Transversal, multicenter study with cohort comparison.

Scope

Six Primary Health Care Centers of the Consorci Sanitari de Terrassa, a comprehensive health organization managing our hospital for acute cases, a social-health centre, a high performance sports center and primary care for a basically industrial and urban area covering a population of 204,810 inhabitants.

Included population

Overall, 1321 diabetic patients over 14 years of age attended to in 6 PHC centers of the Consorci Sanitari de Terrassa from October 1, 2010 up to September 30, 2011.
Interventions

Diabetic patients of 3 PHC centers (n = 938) underwent a complete ophthalmological examination: VA assessments, tonometry for assessing IOP and ocular fundus photography with non-mydriatic retinal camera (OPFNMC). The patients of the 2 remaining centers (n = 383) underwent only OPFNMC (partial examination).

Infrastructure

Ophthalmological examinations were carried out in the ophthalmology rooms located in 2 PHC centers equipped with the following devices:

- Far vision optotypes and multistenopeic holes for VA examination.
- Air jet tonometer for assessing IOP (Nidek AF 13 358; NIDEK Inc., Fremont, USA).
- Non-mydriatic retinal camera equipped with digitizer for ocular fundus photography (Canon CR6-built digitizer 45 nm MV300; Canon USA, Lake Success, USA).

The examination was carried out by an optometrist technician and interpreted by 2 PHC physicians of the Diabetic Patient Ocular Pathology Screening Unit of the Consorci Sanitari de Terrassa.

Execution process of the basic ophthalmological examination

Projection optotypes were utilized for assessing the VA. If the patient uses corrective spectacles they must be worn. If VA reduction is observed, it must be verified by means of a multistenopeic hole.

The recorded IOP value is the mean of 3 consecutive measurements.

At least one photograph of each eye must be taken. According to their quality they can be repeated as many times at the optometrist considers appropriate in the absence of obstacles preventing visualization of the ocular fundus. The criteria applied by VA alterations and suspected glaucoma diagnostics as well as the classification of the various types of diabetic retinopathy are referred in Table 1.5

According to their quality, the photographs were classified in 5 categories: 1) excellent quality; 2) definition of most retina details; 3) limited definition; 4) only visualization of large details, and 5) details not visible. In category 4 and 5 photographs, the optometrist recorded the possible reasons for their poor quality (miosis, cataracts, nystagmus, blinking, palpebral ptosis, lack of patient cooperation). The PHC physician derived patients with category 4 and 5 photographs to the ophthalmology service considering that they did not offer sufficient quality for an adequate diagnostic.

The PHC physician members of the unit derived to the Ophthalmology Service patients with suspected disorders. The referral criteria are described in Table 2. The patients who gave normal results in all examinations will be issued a new appointment twice a year by the User Care Service.7 The patients with regular checkups schedules with their reference ophthalmologists were not referred even though they were included at the beginning of the study.

The PHC physician of each patient received in their computerized clinical records the results of the examinations and the indications for referral to the Ophthalmology Service, if applicable.

Statistical study

The statistical study was carried out with the statistical application SPSS-PASW Statistics 18.0 (IBM Spain S.A., Madrid, Spain).

In the course of the present study the guidelines of the Helsinki Declaration have been followed. At all times it was considered that the interventions were safe, efficient, effective, accessible and of good quality for patients, taking into account the principles of non-maleficence and the code of ethics of the Society of Physicians.

A description of the population under study was carried out, presenting the results of the qualitative variables with

---

### Table 1 – Diagnostic criteria for suspected ocular disease in diabetic patients.

<table>
<thead>
<tr>
<th>Visual acuity (VA) alterations</th>
</tr>
</thead>
<tbody>
<tr>
<td>VA &lt; 0.15 uncorrected with stenopeic</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Suspected glaucoma</th>
</tr>
</thead>
<tbody>
<tr>
<td>One or more of the following alterations</td>
</tr>
<tr>
<td>Intraocular pressure ≥ 22 mm Hg</td>
</tr>
<tr>
<td>Papillary hemorrhage</td>
</tr>
<tr>
<td>Papillary cup asymmetry ≥ 20%</td>
</tr>
<tr>
<td>Unevenness in papillary cup</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Classification of diabetic retinopathy (DR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slight-moderate DR without macular involvement</td>
</tr>
<tr>
<td>Severe-very severe DR</td>
</tr>
<tr>
<td>Pre-proliferative DR</td>
</tr>
<tr>
<td>Proliferative DR</td>
</tr>
<tr>
<td>Clinically significant macular edema</td>
</tr>
</tbody>
</table>

### Table 2 – Referral criteria to ophthalmology service.

<table>
<thead>
<tr>
<th>Deferred referral (&lt;30 days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>One or more of the following alterations:</td>
</tr>
<tr>
<td>Visual acuity &lt; 0.15</td>
</tr>
<tr>
<td>Intraocular pressure between 22 and 29 mm Hg without papillary alteration</td>
</tr>
<tr>
<td>Intraocular pressure between 22 and 25 mm Hg with papillary alteration</td>
</tr>
<tr>
<td>Slight-moderate DR without maculopathy</td>
</tr>
<tr>
<td>Ocular fundus not adequately visible</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Priority referral (between 7–30 days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>One or more of the following alterations:</td>
</tr>
<tr>
<td>Visual acuity &lt; 0.15</td>
</tr>
<tr>
<td>Intraocular pressure &gt; 30 mm Hg without papillary alteration</td>
</tr>
<tr>
<td>Intraocular pressure between 26 and 29 mm Hg with papillary alteration</td>
</tr>
<tr>
<td>Severe-very severe DR</td>
</tr>
<tr>
<td>Proliferative DR</td>
</tr>
<tr>
<td>Clinically significant macular edema</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Urgent referral (&lt;7 days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intraocular pressure &gt; 35 mm Hg</td>
</tr>
</tbody>
</table>

---
Fig. 1 – Type of ophthalmological examination.

Fig. 2 – Referral of patients to the ophthalmology service according to the type of examination.

Fig. 3 – Referral of patients to the ophthalmology service according to the suspected diagnostic.

absolute and relative frequencies. The relationship among variables was analyzed utilizing the Chi-square hypotheses contrast test for comparison purposes. The statistical significance level was 5%.

Results

During the period of the study, 1672 diabetic patients were given appointments for examination and 21% (351) did not attend, representing an examination coverage of 79% (1,321).

Full ophthalmological examinations were carried out (OPPNMC, VA and IOP assessment) in 938 patients and partial examinations (OPPNMC) in 383 (Fig. 1).

DR suspicion was observed in 123 cases (9.3%), of which 90% were slight or moderate DR. No significant differences were observed (p = 0.687) between the full ophthalmological examination (9.1%) (87 cases) and the partial examination (9.3%) (36 cases).

The existence of glaucoma was suspected in 89 cases (6.7%), 76 of which (8.1%) in the full examination and 13 cases (3.4%) in the partial one, where this diagnostic was made only due to papillary alteration observed in OPPNMC.

VA alterations were detected in 169 cases (18%) of the full ophthalmological examinations.

The referrals to the Ophthalmology Service, according to the type of examination and the difference diagnostics are described in Figs. 2 and 3.

Discussion

Ocular fundus examination with the non-mydriatic retinal camera has demonstrated to be a cost effective method. The growing popularity of this examination method has facilitated DR screening by increasing the ophthalmoscopy examination coverage of the diabetic population. In addition, increased coordination among healthcare levels has achieved, in our experience, significantly high examination coverage which exceeds that described in our environment.

MD exhibits a relative risk of blindness 20 times greater than nondiabetic populations. The higher prevalence of cataracts (1.6 times more frequent) in the diabetic population makes it advisable to check VA and tonometry in these patients. In the course of the full ophthalmological examination of this study, 18% of patients with VA alterations were detected as well as 8% of patients with suspected glaucoma who would have gone unnoticed with a routine ocular fundus examination only.

The increased referrals to specialized attention in the full ophthalmological examination is due to the diagnostic suspicion of ocular disease other than DR because the proportion of referrals due to suspected DR is similar in both groups of examined patients. Accordingly, the detection of the VA alterations and suspected glaucoma involved 23% more referrals. However, patients with VA loss are those who, in a relatively long period of time, will visit the ophthalmology practices due to functional alterations preventing them from carrying out daily activities. In the case of loss of vision due to cataracts, delays in visiting the ophthalmologist practice do not have the same consequences than in the case of glaucoma, where delays in obtaining an appointment could involve irreversible vision loss. Accordingly, the authors consider tonometry important to identify at an early stage those patients who initially are asymptomatic.

The ease of screening provided by retinography and good coordination among different healthcare levels improves the rationalization of the appointments for ophthalmology services for the diabetic population. The increase of visits is due to disorders detected by a full ophthalmological examination,
which can be offset by a reduction in the number of visits by diabetic patients without ocular disease. In other words, diabetic patients with ocular disease will have more priority for obtaining appointments with the ophthalmologist.

To conclude, ocular fundus examination only excludes diagnosing diabetic patients with ocular diseases other than DR, probably associated to the greater prevalence of cataracts and glaucoma in this population. It is considered that systematic screening of ophthalmological disease of the diabetic patient should include VA and IOP assessments in addition to ocular fundus examination.

Conflict of interest

No conflict of interests has been declared by the authors.

References