Causes of Visual Impairment in Thai Diabetic Patients in the Visual Rehabilitation Clinic

Apichart Singalavanija MD*,
Kanin Luangsawang MD*, Suksri Chotikavanich MD*,
Jutalai Tanterdtham MD*, Patthanee Samsen MD*

** Department of Ophthalmology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand*

Background: *Visual disability from diabetic retinopathy is one of many public health problems. Knowing the causes of blindness and low vision in diabetic patients will help in policy planning in order to reduce diabetic complications and prevent blindness.*

Objective: *To study the causes of visual impairment, blindness and related factors in diabetic patients who registered at the visual rehabilitation clinic, Siriraj Hospital, Mahidol University, Bangkok.*

Material and Method: *A retrospective study of 133 diabetic patients who registered at the visual rehabilitation clinic between January 2007 and December 2010 was conducted. The patients were divided into 2 groups: a low vision group (VA in the better eye <6/18-3/60) and a blindness group (VA in the better eye <3/60 – No light perception). The history of diabetic mellitus, associated systemic diseases, laboratory investigations, ocular changes and treatment were recorded. The causes of visual impairment and blindness were collected and analyzed.*

Results: *Of a total of 133 diabetic patients, 93 cases (69.9%) were in a low vision group and 40 cases (30.1%) were in a blindness group. The causes of visual impairment were proliferative diabetic retinopathy (84.6%), retinal detachment (37.2%), macular edema and scar (25.9%), optic atrophy (14.3%), neovascular glaucoma (11.7%) and vitreous hemorrhage (4.9%). Tractional retinal detachment (p-value < 0.001) and optic atrophy (p-value = 0.021) were the associated factors causing blindness in visual disability patients with statistical significance. Optic atrophy (38 eyes) occurred post vitrectomy in 19 eyes.*

Conclusion: *Visual disability in diabetic patients is caused by the complications of diabetic retinopathy and its management. The prevention of disease progression, especially macular edema and proliferative diabetic retinopathy, will decrease the rate of visual impairment and blindness.*

Keywords: *Diabetes mellitus, Diabetic retinopathy, Visual impairment, Optic atrophy, Low vision, Blindness*

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Diabetes mellitus (DM) is a public health problem worldwide. In 2002 WHO estimated that there were 37 million blind and 124 million having low vision and one of the leading causes was diabetic retinopathy[1].

In the year 2000, the survey of DM in Thailand showed that the estimated prevalence of DM in the people aged 35 years or more was 9.6% (2.4 million)[2] and in 2003, a study of 9,419 diabetic patients from 11 tertiary care hospitals showed that 30.7% of the patients had diabetic retinopathy, the prevalence of type 1 DM was 21.6% and type 2 DM was 31.4%[3-5].

Patients with DM have pathological change in many structures of the eye, including iris, lens, vitreous, retina and optic nerve. The major causes of blindness and visual impairment are proliferative diabetic retinopathy, vitreous or preretinal hemorrhage, macular edema, optic nerve damage and retinal detachment[6,7].

There are many reports showing the prevalence of diabetic retinopathy in various parts of Thailand[8-16], but the causes of blindness from diabetic retinopathy in diabetic patients have not been reported in detail. The authors would like to study the causes of blindness, visual impairment and the related factors in

Correspondence to:
Singalavanija A, Department of Ophthalmology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.
Phone: 0-2411-2006, Fax: 0-2411-1906
E-mail: siasn@mahidol.ac.th

patients with diabetic retinopathy who registered at the visual rehabilitation clinic, Siriraj Hospital, Mahidol University. The present study will be beneficial for prevention of visual disability in diabetic patients in Thailand.

Material and Method

The retrospective chart review of 160 diabetic patients who registered at the visual rehabilitation clinic, Siriraj Hospital, Mahidol University, Bangkok from January 2007 to December 2010 was conducted. The present study was approved by Siriraj Institutional Review Board (certificate of approval no. Si 367/2010). During 2007-2010, 498 patients were registered at visual rehabilitation clinic and 160 cases (32.1%) were diabetic patients. Only 133 patients had completed data available for analysis.

The visual rehabilitation clinic included patients with visual impairment which divided into low vision and blindness. The eligible criteria were patients with diabetic retinopathy who had low vision or blindness attended at the visual rehabilitation clinic. Low vision was defined as visual acuity of less than 6/18 to 3/60, or a corresponding visual field loss to less than 20 degrees in the better eye with best correction. Blindness is defined as visual acuity of less than 3/60 to no light perception or a corresponding visual field loss to less than 10 degrees in the better eye with best correction. The exclusion criterias were patients who had visual impairment from other eye diseases or who had previous eye injuries.

Associated systemic diseases such as hypertension, hypercholesterolemia, chronic kidney disease, laboratory investigations such as level of fasting blood sugar, hemoglobin A1c, cholesterol, proteinuria, history of previous laser treatment and vitreoretinal surgery were recorded. The visual acuity, ocular tension, slit lamp biomicroscopy and fundus examination for anterior and posterior segment of the eyes were recorded.

Patients with hypertension were defined as patients with a mean blood pressure higher than 140/90 mmHg or patients who received anti-hypertensive medication at the time of examination.

Patients with hypercholesterolemia were defined as patients with cholesterol level higher than 200 mg/dl or patients who received anti-cholesterol medication.

Patients with diabetic nephropathy defined as patients with persistent albuminuria (albumin in urine more than 300 mg/day or more than 200 mcg/min)

All data were recorded in case record form and analyzed using PASW statistics 18.0 (SPSS Inc. Chicago, Illinois, USA). Categorical variables were described in number and percentage whereas continuous variables were expressed in mean, standard deviation, or median and range, as appropriate. Student's t-test or Mann-Whitney U test was used to compare continuous variables and Chi-square or Fisher's exact test was used to compare categorical variables. Simple and multiple logistic regressions were used to determine the factors associated with blindness. A p-value of less than 0.05 was considered statistical significant difference.

Results

133 diabetic patients who attended the visual rehabilitation clinic were 59 males (44.36%) and 74 females (55.64%), 93 cases (69.9%) were in the low vision group and 40 cases (30.1%) were in the blindness group, mean age was 57.12 $\pm$ 10.12 years. Six cases were type 1 DM (4.51%) and 127 cases were type 2 DM (95.49%). The present study group had a mean duration of DM of 10.64 $\pm$ 7.78 years, mean hemoglobin A1c of 7.87 $\pm$ 1.42 %, mean cholesterol of 224.35 $\pm$ 61.18 mg/dl, 31.6% of the patients had hypertension, 21.8%, nepropathy, and 19.5% cardiovascular diseases (Table 1).

When comparing the low vision group and the blindness group, there was no statistical significance between each charactertistic (Table 1).

The causes of visual impairment were proliferative diabetic retinopathy (84.6%), retinal detachment (tractional and rhegmatogenous detachment, 37.2%), macular edema and scar (25.9%), optic atrophy (14.3%), neovascular glaucoma (11.7%) and vitreous hemorrhage (4.9%) (Table 2)

The causes of blindness were proliferative diabetic retinopathy (90.0%), tractional retinal detachment (53.8%), optic atrophy (25.0%), neovascular glaucoma (18.8%) and non-clearing vitreous hemorrhage (10.0%) (Table 2). In the present study there were optic atrophy 38 eyes (30 cases) and the optic atrophy occurred post vitrectomy in 19 eyes (15 cases).

Univariate analysis showed that tractional retinal detachment, optic atrophy, neovascular glaucoma and vitreous hemorrhage were associated with blindness, the odds ratios were 4.11 (95% CI 2.35, 7.19, $p < 0.001$), 3.11 (95% CI 1.54, 6.28, $p = 0.002$), 2.45 (95% CI 1.15, 5.24, $p = 0.021$), 4.02 (95% CI 1.27, 12.71, $p = 0.018$), respectively (Table 3). However, the results from multivariate analysis indicated that only the tractional retinal detachment and optic atrophy were

Table 1. Demographic data of the diabetic patients with visual impairment

Variable	Total (n = 133)	Group		p-value
		Low vision (n = 93)	Blindness (n = 40)	
Male	59 (44.4%)	42 (45.2%)	17 (42.5%)	0.926
Age				
Mean ± sd	57.12 ± 10.12	57.69 ± 9.18	55.80 ± 12.06	
Median (min, max)	58 (31, 87)	59 (31, 76)	55.5 (32, 87)	0.326
Duration of diabetes				
Mean ± sd	10.64 ± 7.78	10.54 ± 7.68	10.88 ± 8.10	
Median (min, max)	10 (0, 30)	10 (0, 30)	10 (1, 30)	0.933
HbA1c	n = 71	n = 48	n = 23	0.442
Mean ± sd	7.87 ± 1.42	7.96 ± 1.49	7.68 ± 1.29	
Median (min, max)	7.7 (5.3, 12.1)	7.75 (5.3, 12.1)	7.6 (5.7, 10.0)	
Cholesterol	n = 58	n = 40	n = 18	0.922
Mean ± sd	224.35 ± 61.18	224.88 ± 59.82	223.17 ± 65.88	
Median(min, max)	214.50 (124, 419)	214.50 (124, 382)	214.50 (145, 419)	
DM type				0.365
DM type 1	6 (4.5%)	3 (3.2%)	3 (7.5%)	
DM type 2	127 (95.5%)	90 (96.8%)	37 (92.5%)	
Hypertension	42 (31.6%)	26 (28.0%)	16 (40.0%)	0.243
Nephropathy	29 (21.8%)	17 (18.3%)	12 (30.0%)	0.203
Cardiovascular disease	26 (19.5%)	19 (20.4%)	7 (17.5%)	0.879

Table 2. Causes of visual impairment in a low vision and a blindness group

Cause	Total (eyes) n = 266	Low vision (eyes) n = 186	Blindness (eyes) n = 80	p-value
PDR	225 (84.6%)	153 (82.3%)	72 (90.0%)	0.156
TRD	84 (31.6%)	41 (22.0%)	43 (53.8%)	<0.001**
Combined TRD & RRD	15 (5.6%)	7 (3.8%)	8 (10.0%)	0.077
Macular edema	49 (18.4%)	35 (18.8%)	14 (17.5%)	0.935
Macular scar	20 (7.5%)	15 (8.1%)	5 (6.3%)	0.794
Optic atrophy	38 (14.3%)	18 (9.7%)	20 (25.0%)	0.002**
NVG	31 (11.7%)	16 (8.6%)	15 (18.8%)	0.031*
Vitreous hemorrhage	13 (4.9%)	5 (2.7%)	8 (10.0%)	0.024*

*,** Significant at 0.05, 0.01 level respectively.
PDR = proliferative diabetic retinopathy, TRD = tractional retinal detachment
RRD = rhegmatogenous retinal detachment, NVG = neovascular glaucoma

associated with blindness; the adjusted odds ratios were 3.33 (95% CI 1.77, 6.29, p < 0.001), 2.48 (95% CI 1.15, 5.37, p = 0.021).

Discussion

Previous studies showed that the causes of visual loss in diabetic patients were proliferative diabetic retinopathy (PDR), vitreous hemorrhage, macular edema, macular pigmentary change, retinal detachment, neovascular glaucoma and others[6,7]. A study from Arhus Country, Denmark, showed that the cause of registered blindness in type 1 DM, was PDR, while type 2 DM caused by PDR and maculopathy[17]. In Europe, multicenters study (EURODIAB IDDM) for type 1 DM showed that factors significantly related to visual loss were age, duration of diabetes, glycated hemoglobin (Hb A1c) and level of retinopathy. Blood pressure, triglyceride and fibrinogen were also the risk

Table 3. Univariate and multivariate analysis of the factors associated with blindness

Cause	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
PDR	1.94 (0.85, 4.42)	0.114	1.03 (0.40, 2.62)	0.955
TRD	4.11 (2.35, 7.19)	<0.001**	3.33 (1.77, 6.29)	< 0.001**
Combined TRD & RRD	2.84 (0.99, 8.12)	0.051	1.96 (0.61, 6.33)	0.259
Macular edema	0.92 (0.46, 1.81)	0.799	1.49 (0.66, 3.36)	0.342
Macular scar	0.76 (0.27, 2.17)	0.608	1.16 (0.38, 3.57)	0.793
Optic atrophy	3.11 (1.54, 6.28)	0.002**	2.48 (1.15, 5.37)	0.021*
NVG	2.45 (1.15, 5.24)	0.021*	2.11 (0.90, 4.94)	0.087
Vitreous hemorrhage	4.02 (1.27, 12.71)	0.018*	3.20 (0.90, 11.43)	0.074

*, ** Significant at 0.05, 0.01 level respectively.
PDR = proliferative diabetic retinopathy, TRD = tractional retinal detachment
RRD = rhegmatogenous retinal detachment, NVG = neovascular glaucoma

factors of severe nonproliferative and proliferative diabetic retinopathy[18].

In the present study, the diabetic patients with visual impairment were in the old age group, they had an average duration of DM of 10 years with mean Hb A1c of 7.8 % and mean cholesterol of 224 mg/dl. The associated systemic diseases were hypertension (31.6%), nephropathy (21.8%) and cardiovascular disease (19.5%). The causes of low vision and blindness were PDR with fibrovascular proliferation, vitreous hemorrhage, retinal detachment, macular edema, macular scar, optic atrophy and neovascular glaucoma. Optic atrophy was found in 38 eyes (30 cases), half of this group (19 eyes) showed optic nerve change after vitreoretinal surgery. The causes should be the disturbance of the circulation of the retina and optic nerve. While performing vitrectomy in PDR patient, the surgeon has to raise intraocular pressure to stop bleeding, the older patients with arteriosclerosis are prone to have poor vascular perfusion. These may interfere the circulation around the optic nerve.

The associated factors that caused blindness were tractional retinal detachment and optic atrophy which reflected the severity of the complication and its management. When the retinopathy progressed, the chance of having severe complication with structural damage was high and the rate of blindness increased.

It is accepted that the screening for diabetic retinopathy is necessary for prevention of disease progression. Laser treatment for proliferative diabetic retinopathy is helpful in reducing severe complications such as fibrovascular proliferation, vitreous hemorrhage and subsequent retinal detachment, meanwhile the treatment of diabetic macular edema in nonproliferative diabetic retinopathy will prevent the sequele, especially functional damage of the macula.

The limitation of the present study is that it is retrospective. There were a limited number of patients. Some patients who attended the visual rehabilitation clinic were referred or came from provincial areas, complete laboratory investigations could not be obtained in every case and some cases had to be discarded due to incomplete medical record. A prospective study in a large number of cases and performing special investigations by optical coherence tomography (OCT) and fundus fluorescein angiography (FFA) in most cases should be conducted. In case of diabetic maculopathy, the FFA and OCT will demonstrate more detail in pathological and morphological change of the macula.

In conclusion, the visual impairment in diabetic patients was caused by the progression and complications of diabetic retinopathy. Primary care physicians and endocrinologists who care for diabetic patients should be aware of the macular edema which presents as retinal thickening or hard exudates at the macula, as well as the progression of diabetic retinopathy to the proliferative stage. Appropriate referral to ophthalmologists and early management will reduce the rate of visual disability and blindness in diabetic patients.

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Potential conflicts of interest

None.

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สาเหตุของสายตาพิการของผู้ป่วยเบาหวานในคลินิกฟื้นฟูสมรรถภาพสายตา

อภิชาติ สิงคาลวณิช, คณินท์ เหลืองสว่าง, สุขศรี โชติกวณิชย์, จุฑาไล ตันฑเทอดธรรม, ภัทนี สามเสน

ภูมิหลัง: *การเกิดสายตาพิการจากการเปลี่ยนแปลงของจอตาจากเบาหวานเป็นปัญหาทางสาธารณสุข การทราบสาเหตุของการเกิดตาบอดและสายตาเลือนรางในผู้ป่วยเบาหวานจะมีประโยชน์ต่อการวางแผนในการลดผลแทรกซ้อนจากเบาหวานและป้องกันตาบอด*

วัตถุประสงค์: *เพื่อศึกษาถึงสาเหตุที่ทำให้เกิดสายตาพิการ และปัจจัยที่เกี่ยวข้องที่ทำให้เกิดตาบอดในกลุ่มผู้ป่วยเบาหวานที่มารับการรักษาในคลินิกฟื้นฟูสมรรถภาพสายตา ณ โรงพยาบาลศิริราช*

วัสดุและวิธีการ: *ทำการเก็บข้อมูลย้อนหลังจากเวชระเบียนผู้ป่วยที่มารับการรักษา ในผู้ป่วยทั้งหมด 133 คน ระหว่างเดือนมกราคม พ.ศ. 2550 ถึงเดือนธันวาคม พ.ศ. 2553 แบ่งผู้ป่วยเบาหวานที่มีสายตาพิการเป็น 2 กลุ่ม คือ กลุ่มที่มีสายตาเลือนราง (ระดับสายตาในข้างที่ดี < 6/18-3/60) และกลุ่มที่มีตาบอด (ระดับสายตาในข้างที่ดี < 3/60-มองไม่เห็นแสง) บันทึกประวัติโรคทางกาย ประวัติโรคเบาหวาน ผลการตรวจทางห้องปฏิบัติการ การผ่าตัดรักษา การเปลี่ยนแปลงของนัยน์ตาและจอตา ทำการวิเคราะห์ปัจจัยที่เกี่ยวข้องที่ทำให้เกิดสายตาพิการและตาบอด*

ผลการศึกษา: *ผู้ป่วยเบาหวาน 133 คน เป็นชาย 59 คน (ร้อยละ 44.4) หญิง 74 คน (ร้อยละ 55.6) อายุเฉลี่ย 57.12 ± 10.12 ปี ผู้ป่วยอยู่ในกลุ่มสายตาเลือนราง 93 ราย (ร้อยละ 69.9) และกลุ่มตาบอด 40 ราย (ร้อยละ 30.1) พบสาเหตุของสายตาพิการ ได้แก่ proliferative diabetic retinopathy ร้อยละ 84.6 จอตาลอก ร้อยละ 37.2 มีการบวมและเกิดแผลเป็นที่จุดภาพชัด ร้อยละ 25.9 ประสาทตาฝ่อร้อยละ 14.3 ต้อหินจากหลอดเลือดงอกใหม่ ร้อยละ 11.7 และเลือดออกในวุ้นตา ร้อยละ 4.9 พบปัจจัยที่เกี่ยวข้องที่ทำให้เกิดตาบอดในกลุ่มผู้ป่วยที่มีสายตาพิการ ได้แก่ การเกิดจอตาลอกชนิดมีพังผืดดึงรั้ง (p-value < 0.001) และประสาทตาฝ่อ (p-value = 0.021)) ในกลุ่มสายตาพิการจากประสาทตาฝ่อ (38 ตา) เกิดตามหลังจากการผ่าตัดน้ำวุ้นตา 19 ตา*

สรุป: *การเกิดสายตาพิการในผู้ป่วยเบาหวาน เป็นผลเนื่องจากผลแทรกซ้อนจากเกิดการเปลี่ยนแปลงในจอตา การป้องกันและให้การรักษาการเปลี่ยนแปลงที่จอตาและจุดภาพชัดแต่แรกเริ่ม จะช่วยลดอัตราการเกิดสายตาพิการได้*