

A Co-Relation of the Eye and Kidney - In Diabetes Mellitus and Hypertension

Pages with reference to book, From 320 To 323

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Abstract

The study was undertaken to observe the co-relation between microangiopathic changes in diabetic retinopathy and microvascular changes in diabetic nephropathy. Included in the study were 64 patients with chronic renal failure who were on maintenance dialysis, 40 had hypertension alone, 21 hypertension and diabetes and 3 had diabetes alone. On examination of retina, of 40 hypertensive patients, 14 had positive findings, while in the hypertensive and diabetic group, 20 patients out of 21, had positive findings. Nine patients in the hypertensive group had delayed choroidal filling on fluorescein angiography which was not very accurately reflected on Funduscopy. In the diabetic and hypertensive group, 13 patients having proteinuria of more than 1 gm, also had exudates and haemorrhages in the fundus. It was concluded that a correlation exists between the arterial changes in the fundus of the eye and the glomeruli of the kidney. (JPMA 45:320,1995).

Introduction

A close relationship has been observed between retinopathy and nephropathy in diabetes mellitus. The underlying disorder in both is micro-angiopathy¹, with a good histopathological co-relation. Changes in microcirculation are the result of an increase in blood viscosity and platelet aggregation leading to thickening of retinal capillary wall. Microangiopathy causes hyperpermeability and ischaemia of the vascular territories. Thus in diabetes, the problem is two fold - the complication of the kidney can have a grave prognosis and of the eyes can lead to the risk of blindness². Nephropathy also plays a part in the evolution of retinopathy via the high blood pressure induced through the metabolic imbalance and the pharmacodynamics of therapeutics. Nephropathy has been reported in 50% patients who attend ophthalmology clinics for advanced proliferative diabetic retinopathy; 97% uremic diabetics have retinopathy and of these 50% will develop blindness³. The incidence of diabetic nephropathy in insulin dependent diabetes mellitus is about 30- 40% and after 20 years of non-insulin dependent mellitus it is 50%^{3,4}. It is postulated that diabetic retinopathy is a result of diabetic nephropathy in one-third of all cases³ and appears simultaneously in another third; each stage of diabetic retinopathy can be observed during the development of diabetic nephropathy, however, hypertension that co-exists in most cases induces additive changes in retinal vessels⁵. The changes in the retina can be secondary to diabetes or hypertension or both. Ocular manifestations in systemic hypertension are easily examined by an ophthalmoscope and are correlated directly with the degree and severity of systemic hypertension. With fluorescein angiography the precise retinal changes can be seen especially those which cannot normally be detected with an ophthalmoscope.

Patients and Methods

Sixty-four patients with chronic renal failure on haemodialysis support were studied for ocular manifestations. A funduscopy was performed followed by a fluorescent angiography where indicated. A 24 hours urine protein, blood urea and serum creatinine were estimated on the patients with diabetic

nephropathy. The results obtained were compared for correlation of the eye and kidney lesions.

Results

Of 64 patients with chronic renal failure who were on dialysis, 40 had hypertension alone, 21 hypertension and diabetes and 3 had diabetes alone. Their manage was 49 years with a male to female ratio of 3:1. The first two groups were analysed. The retinal examination of 40 hypertensive patients, gave positive fundus findings in 14. There were 29 males and 11 females with a mean age of 42.6 years and a duration of hypertension of 6.1 years. Thirty of these patients had controlled and 10 uncontrolled blood pressure. To grade the hypertensive changes in the retina, the Keith Wagner Bacler classification was used⁶ (Table I).

Table I. Keith - Wanger - Barker (1939) Classification of hypertensive retinopathy.

Group I	Mild narrowing of retinal arteries
Group II	Narrow retinal arteries Retinal arterio-sclerosis Exaggeration of light reflex
Group III	Generalized arteriolar narrowing edema Cotton wool spots and haemorrhages
Group IV	Group III and papilloedema

As seen in Table II,

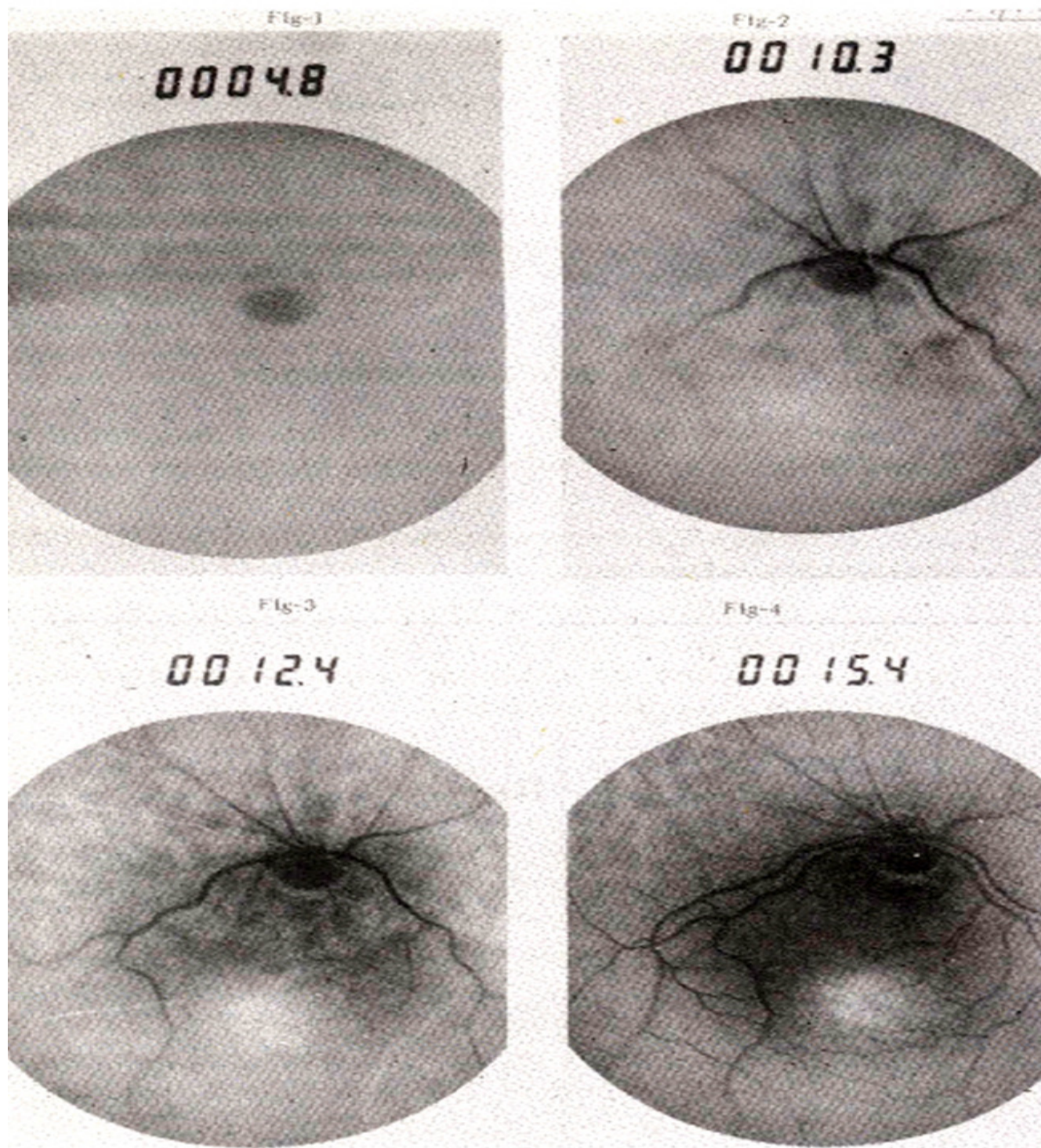
Table II. HTN.

Name	Age	Duration of HTN Yrs.	C/U HTN	U/C	Fundus F	FFA
*M.B.	40	7	U -	159/11	II	Delayed choroid filling
*S.A.	26	1	U -	200/7	II	Delayed choroid filling
*MAG	45	3	- C	96/7.3	II	Delayed choroid filling
*MAL	34	1	- C	52/3.75	II	Delayed choroid filling
*MAR	60	15	U -	68/3.4	II	Delayed choroid filling
*F.M.P.	62	7	- C	175/6.5	II	Delayed choroid filling
*H.M.Y.	46	8	U -	-	II	Delayed choroid filling
*N.M.	55	3	- C	33/1.79	II	Delayed choroid filling
*M.SH	65	4	- C	-	II	Delayed choroid filling
F.S.	39	10m	- C	103/17.6	III	Haem.
G.H.	64	2m	- C	79/7.4	III	Haem.
S.K.	78	20	U -	156/12.5	III	Haem.
S.A.D.	60	1	- C	93/7.17	IV	Haem.

HTN = Hypertension DM = Diabetes Mellitus C/U = Controlled/Uncontrolled
NTM = Normotensive FFA = Fluorescent Angiography

patients 1-9 had grade II changes on funduscopy. This change is hard to interpret by an inexperienced eye and was reflected very precisely as delayed choroidal filling on fluorescein angiography (Figures 1-

4).



Figures 1-4. Delayed choroidal filling (timing in seconds)

Usually, the choroid fills before the arterial and venous filling on fluorescent angiography. Even at 15 seconds, there was patchy filling of choroid - reflecting narrow arterial vessels. In the hypertensive and diabetic group, 20 patients out of 21, 2 had positive findings in the fundus. The mean age was 44.6 years with duration of diabetes being 13 years and of hypertension 6.8 years.

Table III. DN+ESRD+HTN.

Name	Age	Duration		C/U	Proteinuria	Urea	Fundus	FFA
		HTN	DM					
T.V.	52	3m	5	C	C	8.69	192/4	R.E. Haem.
HB	56	4	11	C	C	1.68	93/6	H.Spot B.E.
*AZ	48	1	12	C	C	3.70	90/8	Grade IV Back D.R.P.
S.K.	65	25	11	C	C	1.18	94/11	Bilat pseud.
*S.P.	44	5	18	C	C	1.97	92/11	D.R.P. Maculopathy
*A.B.	50	5	22	C	C	1.79	108/2.9	Mac. Star Haem. Leak
*G.S.	52	14	14	C	U	8.07	65/5	DRP
G.A.	50	4	1	C	C	2.6	135/4.76	Grade II
N.A.	42	1	4	C	C	2.8	56/6.7	DRP
*S.A.	48	7m	20	C	C	1.1	74/5.9	DRP
*K.H.	56	14	14	C	C	2.0	50/3.5	DRP
S.A.	35	15	1	C	C	7.8	109/9.1	Cotton wool
*M.A.	70	10	8	C	C	1.2	112/4.2	DRP

HTN = Hypertension

DM = Diabetes mellitus

C/U = Controlled/Uncontrolled

NTM = Normotensive

FFA = Fluorescent angiography

D.R.P. = Diabetic retinopathy

Table III shows 13 patients of this group having proteinuria ranging from 1.1 gm/24 hours to 7.8 gms/24 hours. This was reflected as diabetic retinopathic changes of exudates and haemorrhages. In this group, diabetic retinopathy dominated in eight out of thirteen patients (Table III).

Discussion

The eye and the kidney are closely linked as both (the Choroid and the Glomerulus) have a large capillary bed made up of fenestrated vessels and the capillary pressure in the choroid and the glomeruli are highest than any other organ of the body⁷. The changes that occur in the eye are secondary to alterations of retinal capillaries including thickening of basement membrane and passive dilation of the capillary net, leading to a breakdown of the internal blood retinal barrier⁸. Fluorescein retinal angiography facilitates the diagnosis of the first signs of diabetic microangiopathy, the assessment of the extent of capillary non-perfusion territories and the classification of diabetic retinopathy according to stage of evolution¹. Fluorescein angiography can reveal localised or diffuse capillary dilation (responsible for retinal oedema) and capillary obliteration (which causes areas of ischaemia)¹. In the kidney, there is an increase of basement membrane like, material in the glomeruli and a reduction of the surface available for filtration followed by compensatory changes in renal haemodynamics including an increase of glomerular capillary flow and pressure. The albuminuria that occurs is a result of basement membrane thickening, mesangial accumulation and changes in glomerular haemo-dynamics^{9,10}. Because the arteries and veins within the human body are mostly covered by skin or mucous membrane, the vascular constriction and sclerosis induced by hypertension are not visualised non-invasively. However, there are several methods or techniques for viewing arteries and veins of the retina, choroid and optic nerve, the important ocular structures affected by systemic hypertension. Retinal capillaries which are normally not visible with an ophthalmoscope can be visualised with fluorescein angiography, leakage, occlusion dilation, micro-aneurysm formation and other pathological alterations of the retinal capillaries also been observed¹¹. The alterations in the retinal vasculature may reflect the status of the vasculature of other organs like the kidney. Hypertension which can be induced by number of renal disease may produce similar renal and ocular vascular changes. Retinal vessels auto-regulate flow in response to changes in blood pressure, ocular pressure and oxygenation of blood. In contrast, the choroidal blood vessels are similar to other systemic blood vessels. There are several possible theories for explaining why the choroidal vasculature, is more severely affected than the retinal vasculature when the abrupt onset of severe hypertension occurs in young patients.

Anatomically, the choroidal arteries run a short course without much branching and supply the choriocapillaris at right angles. The systemic blood pressure is thus transmitted directly to the choriocapillaris¹². The delayed choroidal filling on fluorescent angiography seen in nine of our patients who had stage II hypertensive retinopathy. (Keith Wagner classification) was an interesting finding. The same retina on ophthalmoscope study did not reflect any underlying disorder: The choroid vasculature consists of multiple layers of interwoven blood vessels lying between the retinal pigment epithelium and the sclera. The volume of blood flowing throughout the choroid per minute is one of the highest in the body¹¹. Diabetic retinopathy and glomerulopathy are at first clinically silent. Renal biopsies in asymptomatic diabetics will show thickening of basement membrane and expansion of mesangium -both are signs of micro-vasculopathy¹³. Diabetic background retinopathy represents microvasculopathy 'in progress' prior to visual loss. Over 90% of patients who have diabetic nephropathy have diabetic retinopathy^{14,15}. Usually on ophthalmoscopic examination, the severity may range from a few micro-aneurysms to diffuse proliferative retinopathy with haemorrhages and exudates. Occasionally, more sensitive means of examination, like fluorescein angiography is required to demonstrate the presence of diabetic retinal disease in patients with proven or suspected diabetic nephropathy. Majority of insulin dependent diabetes mellitus patients with renal disease have retinopathy, but the reverse is not true. In a report of 106 patients who were treated for diabetic retinopathy only about 1/3 had proteinuria or evidence of more advanced renal disease¹⁶. In IDDM the incidence of diabetic retinopathy is greater than clinically¹⁴ detectable nephropathy. Thus there is a greater sensitivity of retinal examination for the presence of diabetic microangiopathy compared with clinical diagnosis of diabetic nephropathy. In non- insulin dependent diabetes mellitus, one half of the patients may be free of retinopathy^{17,18}. Thus an association exists between retinopathy and nephropathy in both IDDM and NIDDM but is much stronger in the former. Functional changes in eye and kidney are 'typical' in a hyperglycaemic patient. Leakage from retinal capillaries and micro-albuminuria are the fore-bearers of retinopathy and glomerulopathy respectively. Thus in our study of 24 diabetic patients, the picture of the eye matched with the extent of proteinuria. Knowledge of disease presenting with ocular and renal manifestation like hypertensive or diabetic states would enable the ophthalmologist to recognise early certain types of renal dysfunction. The clinician may be able to monitor the progress of a renal disease by observing the changes in the retinal and choroidal capillaries.

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