SENIOR PROJECT

A Study of Diabetic Retinopathy at the State Prison of Southern Michigan

Peter B. Tacia

April 17, 1989

OVERVIEW OF STUDY

There are approximately ten million diabetic patients in the United States which represents about five percent of the population, and the number of diabetics is increasing by six percent each year. 1 Diabetes is the leading cause of blindness in people aged 25 to 74 in the United States causing five thousand cases of new blindness each year. 2,3

Causes of visual loss in diabetics include cataracts, glaucoma, optic neuropathy, vitritis, and retinopathy. Retinopathy is responsible in about 84 percent of blindness in diabetic patients. 4 Approximately two percent of all diabetics are blind from retinopathy, a prevalence of blindness which is ten times greater than the prevalence of blindness in the general population from any cause. 4

This study was an attempt to discover simularities between diabetics in a prison setting and the general population. As a fourth year optometry student at Ferris State University, I spent three months at the State Prison of Southern Michigan. With help from my instructors, I gathered data on 43 diabetic patients. Factors such as the type of diabetes, onset of diabetes, age of patient, method of control and others were examined.

PATIENTS

All prisoners who enter the state prison system are required to enter a quarantine area before entering the general prison population. At this location all prisoners must have a basic

health check-up including among other things, a vision screening and a blood test. All prisoners who are diagnosed as having diabetes are required to have an eye examination at the Optometry Clinic. In addition, all diabetic prisoners in general population are required to have an eye examination once a year. Approximately one half of the diabetic patients I saw came from quarantine. The other diabetic patients were yearly recalls or had just recently been diagnosed. The diabetic patients I examined were all male. Their ages ranged from 20 to 63 years old.

There was an ophthalmologist on the staff at the prison who also saw patients. All patients, however, were seen at the Optometry Clinic first. Once the Optometry Clinic referred the patient to the ophthalmologist, the ophthalmologist would make the judgement of whether he should follow the patient's condition or the optometrist should do further follow-up care. This fact did limit the number of established cases of proliferative diabetic retinopathy patients I saw. However, most cases of diabetic retinopathy were managed at the Optometry Clinic.

CLASSIFICATION OF DIABETES AND DIABETIC RETINOPATHY

In 1980, the World Health Organization and the American Diabetic Association began promoting new terminology to differentiate one type of diabetes from another. 1,5 The two most common types of diabetes are insulin-dependent diabetes melitis (IDDM) and non-insulin dependent diabetes melitis (NIDDM). This is the same system physicians at the Prison use and the classification system used in this report.

I also used the system most physicians and ophthalmologists use to classify diabetic retinopathy. The retinopathy is divided into background diabetic retinopathy (BDR) and proliferative diabetic retinopathy (PDR) as well as intermediate category of preproliferative diabetic retinopathy. Signs of BDR include microaneurysms, intraretinal dot and blot hemorrhages and hard exudates. Because of the simularities in appearance between microaneurysms and dot hemorrhages, I included these into one category of dot hemorrhages.

Preproliferative retinopathy includes cotton wool spots, venous caliber changes, and intraretinal microvascular abnormalities (IRMA's). Other signs include capillary non-perfusion, which is visible only with fluorescien angiography, and widespread intraretinal and flame shaped hemorrhages.

Proliferative retinopathy includes any of the previous signs with neovascularization of the disc or elsewhere, pre-retinal hemorrhages, vitreal hemorrhaging, fibrotic tissue or tractional retinal detachments.

In addition, macular edema can occur in any diabetic regardless of the classfication. This occurs in over 25 percent of patients who have had diabetes for more than 20 years and is the most common cause of decreased visual acuity from diabetes. 3

SIGNS OF DIABETIC RETINOPATHY

The most common sign of diabetic retinopathy I saw at the Prison was dot hemorrhages. Fourteen patients out of 43 had this sign. Hard exudates was second with 12 patients presenting with this sign. Seven patients had blot hemorrhages and one patient

had a flame hemorrhage. All of these signs are typical of background diabetic retinopathy.

Cotton wool spots was the most common sign of pre-proliferative diabetic retinopathy with three patients presenting with this sign. Another sign of pre-proliferative diabetic retinopathy was venous caliber changes.

Signs of proliferative diabetic retinopathy were neovascularization of the disc and a retinal detachment with fibrotic tissue. One of the patients with PDR also had macular edema.

Of the 86 eyes reviewed in the study, 26 had signs of BDR. Another two had pre-proliferative diabetic retinopathy, and 4 had proliferative diabetic retinopathy.

Photocoagulation was performed on 2 patients. One patient had proliferative diabetic retinopathy in both eyes which had been treated with pan retinal photocoagulation. The other had BDR with retinal edema and was treated with local photocoagulation.

There are other signs of diabetic retinopathy which were not found in the examination of these patients. The most conspicuously missing sign was intraretinal microvascular abnormalities. IRMA's are dialated irregular retinal vessels which are frequently difficult to differentiate from true neovascularization on the surface of the retina. In retrospective, it is possible that this sign was present in a few patients but it was not the most predominate sign.

All of the patients were given a careful slit lamp examination to determine if the diabetes was affecting any

anterior structures. No evidence of this was found. Rubeosis irides was absent, as well as cataracts. In fact none of the patients presented with an abnormally high intraocular pressure. Despite this this fact, glaucoma, rubeosis and cataracts have all been found to be problems in diabetic patients.

On the following page is a table summarizing all of the information which was gathered from the examinations. In addition, table II summarizes the retinopathy signs which were observed.

Key to Table I

Onset-Years since diagnosis
Diag -IDDM vs. NIDDM
F.Hx -Family history
D.R. -Diabetic retinopathy
O.D. -Classification of diabetic retinopathy in right eye
O.S. -Classification of diabetic retinopathy in left eye

CWS -Cotton wool spots
DH -Dot hemorrhages
BH -Blot hemorrhages
NVD -Neovascularization of the disc
HE -Hard exudates
ME -Macular edema
VCC -Venous caliber changes
FH -Flame hemorrhages
RD -Retinal hemorrhages
PhC -Photocoagulation

Y -Yes, present, positive
N -No, absent, negitive
NA -Not available, unknown

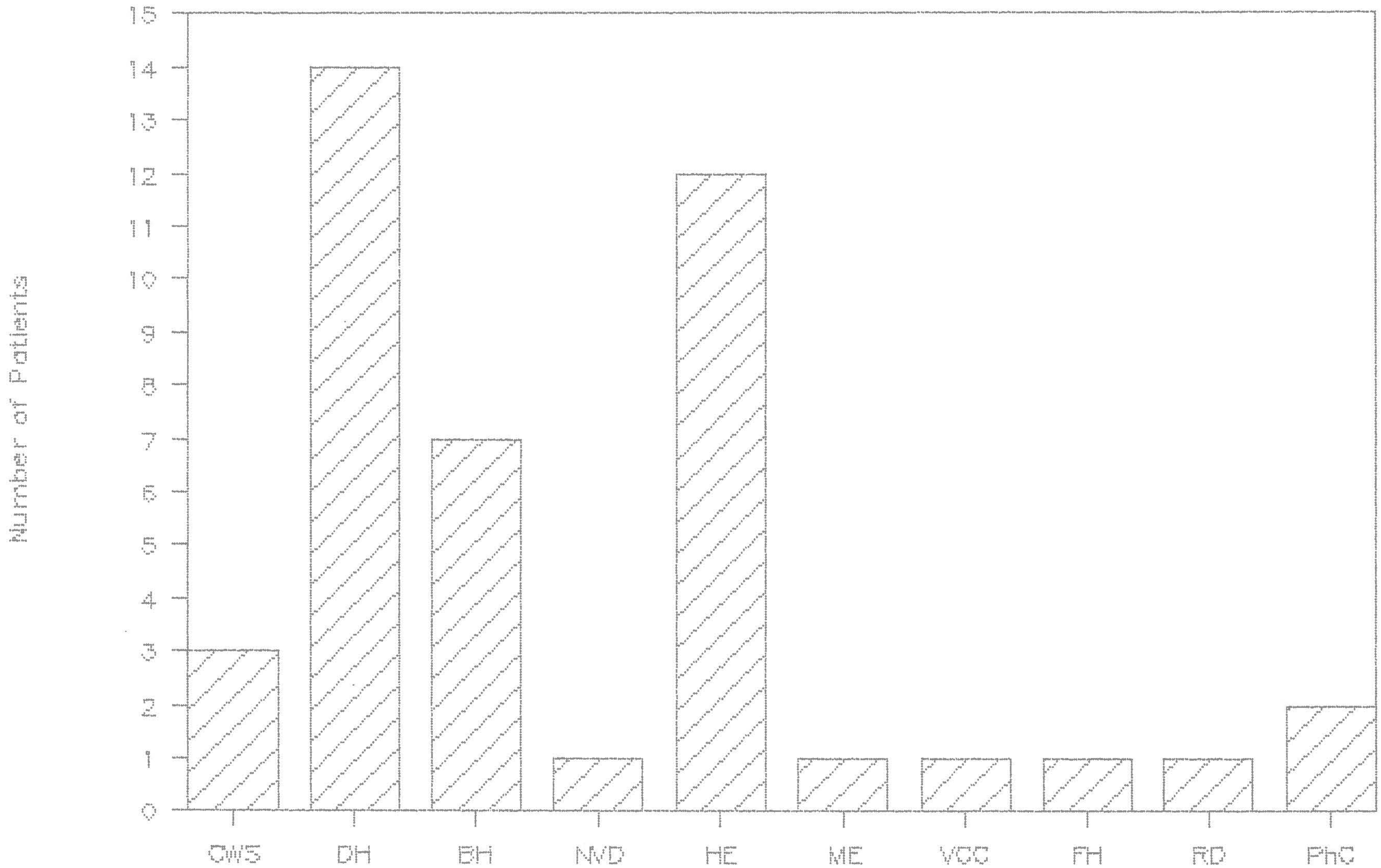
TABLE I

SIGNS:

PT. NO.	RACE	AGE	ONSET	DIAG.	F.Hx.	D.R.	O.D.	O.S.	CWS	DH	BH	NVD	HE	ME	VCC	FH	RD	PhC
1	W	32	14	I	Y	Y	PDR	PDR	Y	Y	Y	Y	Y	N	Y	N	N	N
2	B	63	20	I	N	Y	PrePDR	BDR	Y	Y	Y	N	Y	N	N	N	N	N
3	B	31	25	I	Y	Y	PDR	PDR	Y	Y	Y	N	Y	Y	N	N	Y	Y
4	W	26	10	I	Y	Y	BDR	BDR	N	Y	Y	N	Y	N	N	N	N	N
5	W	47	12	I	Y	Y	BDR	BDR	N	Y	Y	N	Y	N	N	N	N	Y
6	W	39	4	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
7	B	20	B	I	Y	Y	BDR	BDR	N	Y	N	N	N	N	N	N	N	N
8	B	46	7	I	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
9	H	26	1	I	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
10	W	48	13	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
11	W	58	4	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
12	W	62	14	N	Y	Y	BDR	N	N	N	N	N	Y	N	N	N	N	N
13	B	21	11	I	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
14	W	57	3	I	N	N	N	N	N	N	N	N	N	N	N	N	N	N
15	B	38	15	I	NA	N	N	N	N	N	N	N	N	N	N	N	N	N
16	B	50	10	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
17	B	35	15	I	Y	Y	N	BDR	N	Y	N	N	N	N	N	N	N	N
18	H	42	7	N	Y	N	N	N	N	Y	N	N	N	N	N	N	N	N
19	W	35	14	I	Y	Y	N	BDR	N	N	N	N	N	N	N	Y	N	N
20	W	41	29	I	Y	Y	BDR	BDR	N	N	N	N	Y	N	N	N	N	N
21	B	30	6	I	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
22	B	28	4	I	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
23	W	42	6	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
24	B	40	3	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
25	W	33	5	I	Y	Y	BDR	BDR	N	Y	N	N	N	N	N	N	N	N
26	B	48	13	N	Y	Y	BDR	BDR	N	N	N	N	Y	N	N	N	N	N
27	W	60	2	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
28	B	44	7	I	N	Y	BDR	BDR	N	N	N	N	Y	N	N	N	N	N
29	B	46	3	I	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
30	B	49	5	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N
31	B	27	10	I	N	Y	BDR	BDR	N	Y	N	N	Y	N	N	N	N	N
32	B	42	16	I	Y	Y	N	BDR	N	N	N	N	N	N	N	N	N	N
33	B	41	8	I	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
34	W	50	13	N	N	Y	BDR	PrePDR	N	Y	Y	N	Y	N	N	N	N	N
35	B	61	23	I	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
36	W	43	8	N	Y	Y	N	BDR	N	Y	N	N	N	N	N	N	N	N
37	B	32	1	I	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
38	B	46	NA	N	Y	Y	BDR	N	N	N	Y	N	N	N	N	N	N	N
39	B	49	18	I	Y	Y	BDR	BDR	N	Y	N	N	Y	N	N	N	N	N
40	B	36	2	I	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
41	W	53	6	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N
42	H	26	2	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
43	W	28	1	I	Y	N	N	N	N	N	N	N	N	N	N	N	N	N

SIGNS OF DIABETIC RETINOPATHY

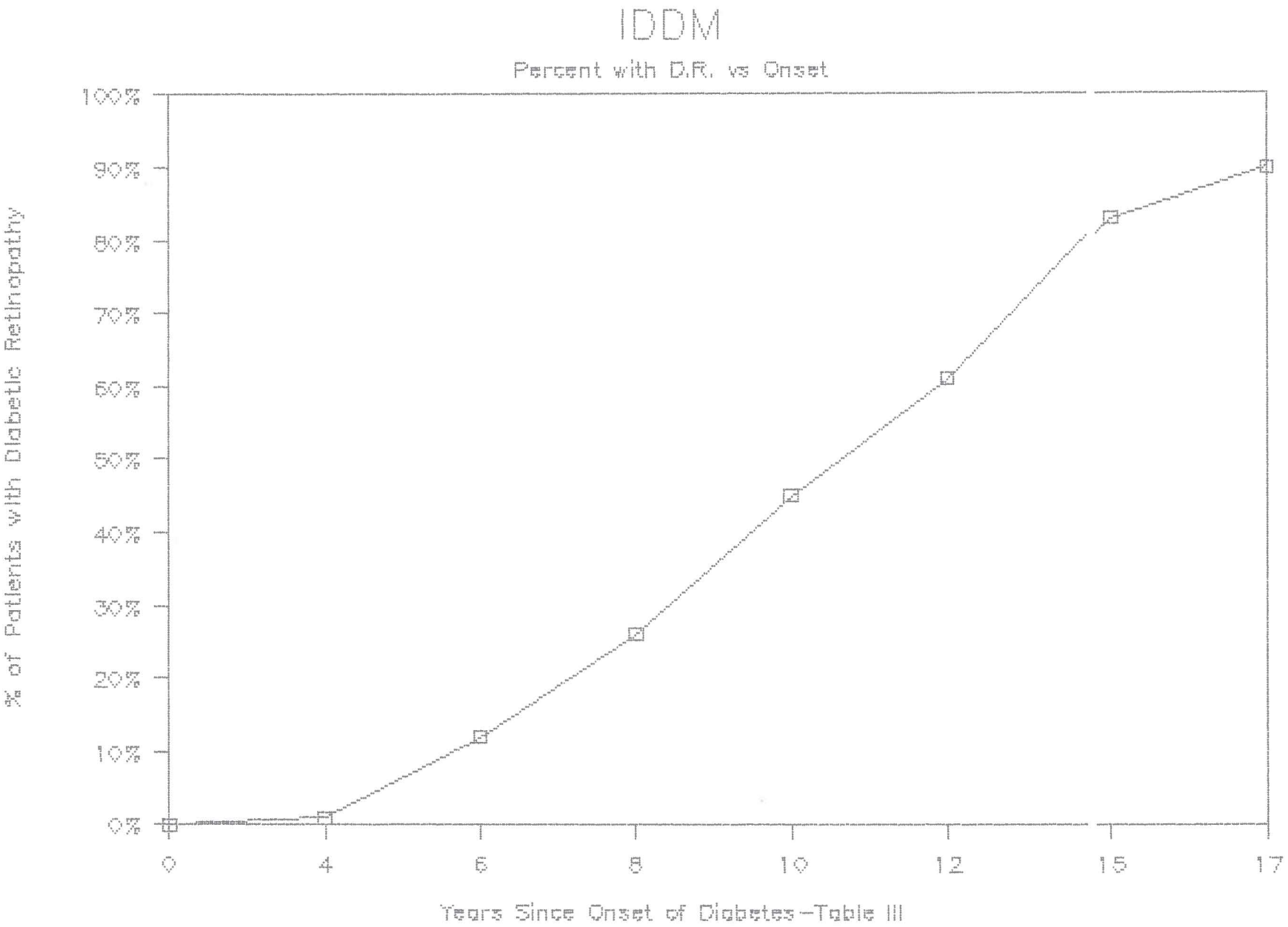
Table II



ONSET vs. DIABETIC RETINOPATHTY

The prevalence of all types of diabetic retinopathy is positively correlated with the duration of diabetes. Numerous studies have been done determining the percentages of people having diabetes versus the number of years the patients have had diabetes.

The results of a study by Klein in 1984 is graphed on Table III. 6 He demostrated that the risk of diabetic retinopathy in IDDM was minimal before the fifth year. 6 The risk increased until the fourteenth year when almost all insulin-dependent diabetics had some form of diabetic retinopathy. 6 A study by Caird in 1968 demostrated that the prevalence of diabetic retinopathy in IDDM was seven percent in patients with diabetes for less than ten years, but rose to 65 percent in patients with diabetes for 15 years or more. 2 Most studies seem to show that diabetes is present in about 50 percent of people who have had diabetes for ten years and approximately 100 percent of patients who have had diabetes for atleast 17 years. 7 Diabetic retinopathy also tends to occur sooner in NIDDM patients. 2 Approximately 20 to 30 percent of NIDDM patients develop diabetic retinopathy within five years. 8 However, the overall prevalence of retinopathy in diabetes of long duration appears to be lower in NIDDM then it is in IDDM, and blindness after 30 years of diabetes also is less common in NIDDM then in IDDM. 8


IDDM
Percent with D.R. vs Onset
% of Patients with Diabetic Retinopathy
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
4
6
8
10
12
15
17
Years Since Onset of Diabetes—Table III

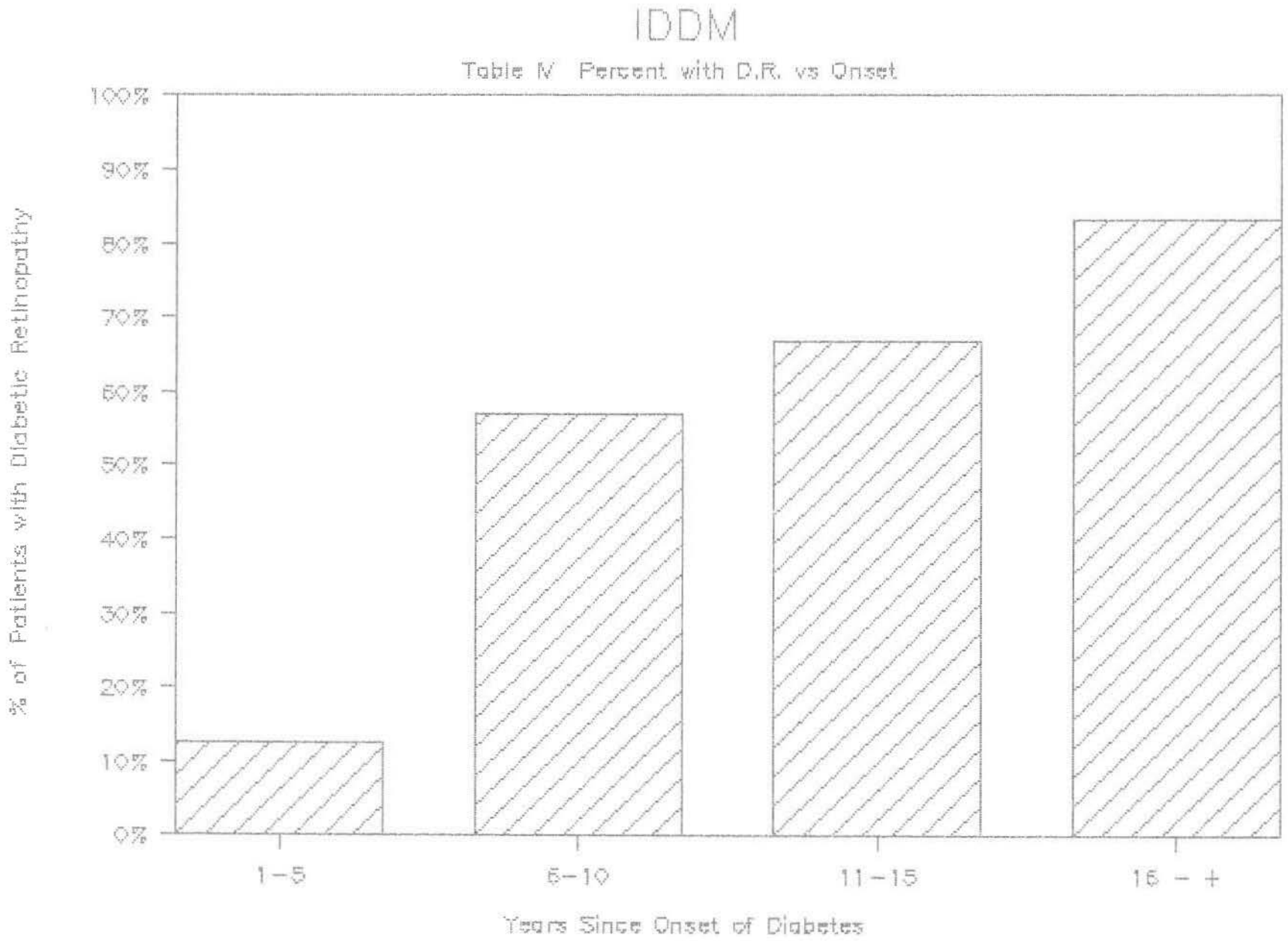
The results of my study are given in Tables IV and V. The results were very similar to previous studies. Once again the incidence was low in the first five years of IDDM but rapidly increased between the fifth and tenth years. After 20 years, 80 percent of the patients showed some signs of diabetic retinopathy.

The results from the NIDDM patients was interesting due to the fact that the percentage of patient with diabetic retinopathy was lower than the expected norms for the first ten years. This may have been due to the fact that the age of the patients I saw was less than the age of the patients in the general population having NIDDM.

PATIENT COMPLIENCE

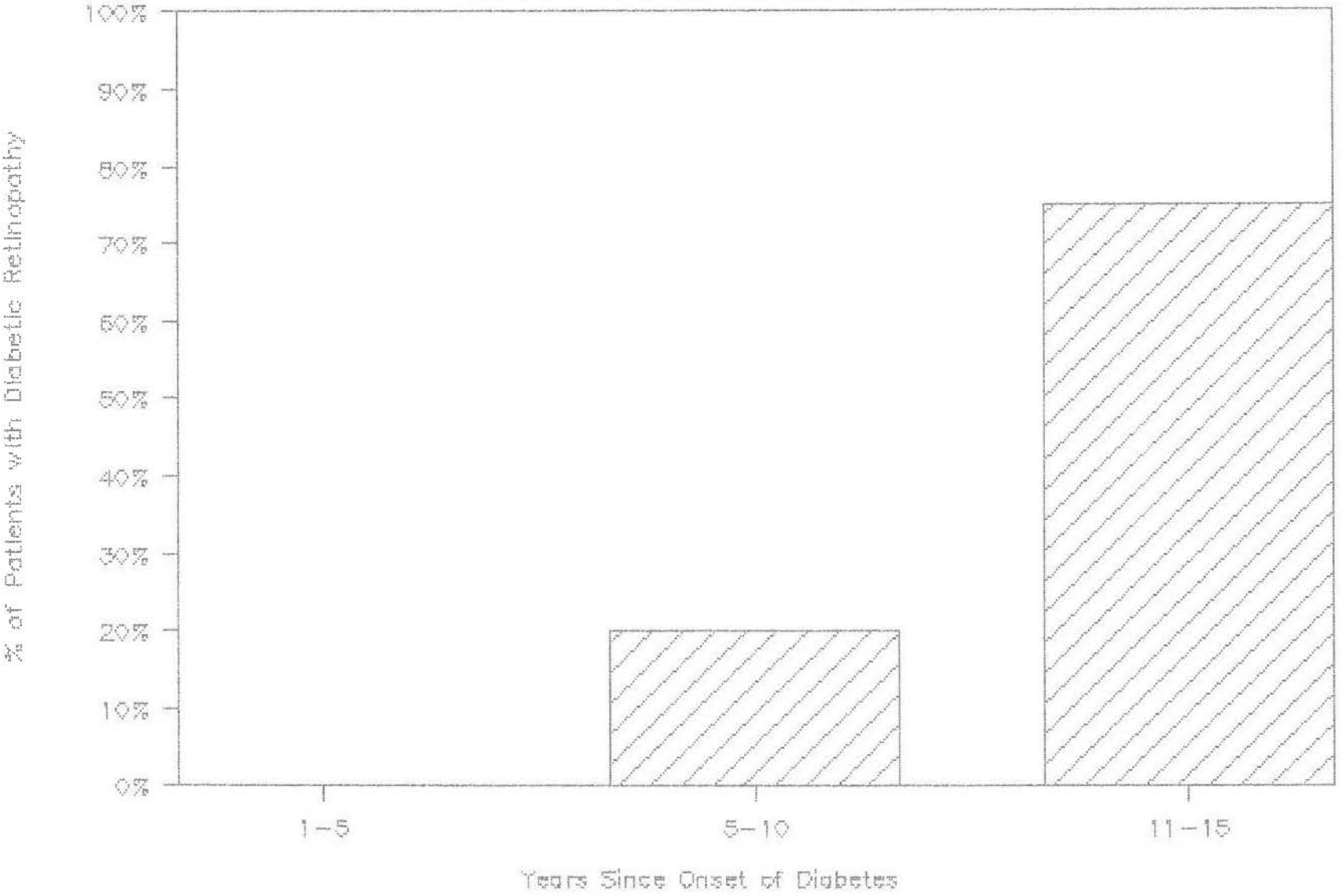
I attempted to determine how well the prisoners were controlling their diabetes. This turned out to be an impossibility due to the fact that prisoners had lived totally different lifestyles outside of the prison and because their case histories were unreliable concerning their compliance. Overall, I felt that they tended to have poorer compliance than patients in the general population.

Retrospective studies examing the relationship of glycemic control with the long term complications of diabetes have generally yielded inconclusive results. 9 Newer long term randomized controlled studies are being performed to study blood glucose level and their impact on early diabetic retinopathy. Information from these studies has not yet been released. Because of the small number of patients I examined, it is


IDDM
Table IV Percent with D.R. vs Onset
% of Patients with Diabetic Retinopathy
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1-5
6-10
11-15
16 - +
Years Since Onset of Diabetes

NIDDM

Table V Percent with D.R. vs Onset



difficult to make any conclusions concerning this question. However, patient compliance was probably poorer than average and the onset of diabetes generally correlated with expected norms.

FAMILY HISTORY

A family history of diabetes was present in a significant number of the diabetic patients. Of the 27 patients with IDDM, 22 had a family history of diabetes. Of the 16 patients with NIDDM, 12 had a history of diabetes. Any history of diabetes must be elicited from the patient in the case history. This study only reinforces this fact.

CONCLUSION

No significant differences in ocular complications were found in diabetics at the State Prison of Southern Michigan than from diabetes in the general population. The stardard of care provided to the diabetic patients at the Prison must be equal to that given to any diabetic patient.

References

1 Campbell, Keith, "Counseling the Diabetic Patient," NARD Journal, Septemter 1983.

2 Barr, Charles C., "Diabetic Retinopathy," Journal of the Kentucky Medical Assiociation, 155-158, April, 1886.

3 Malinovsky, Victor, "Optometric Management of the Diabetic Patient," Ferris State College, Lecture Notes, 1987.

4 Liang, James C., "Treatment of Diabetic Retinopathy," Diabetes, 29:841-851, October, 1980.

5 Bennett, Peter H., "Early Detection and Intervention in Diabetes Mellitus," J Chron Dis, 37:653-666, 1984.

6 Krolewski, Andrzej S., "Epidemiologic Approach to the Etiology of Type I Diabetes Mellitus and Its Complications," The New England Journal of Medicine, 317:1390-1398, November 26, 1987.

7 Calderon, Richard M., "Update: The Diabetic Eye," Compemporary Optometry, 2:21-29, May, 1983.

8 Watkins, P.J., "Diabetic Complications of Non-Insulin-Dependent Diabetes," Diabetic Medicine, 4:293-296, 1987.

9 Gerich, John E., "Insulin-Dependent Diabetes Mellitus: Pathophysiology," Mayo Clinical Proc, 61:787-790, October, 1986.