Diabetic retinopathy
(diagnostics, therapy, classification)

Diabetes mellitus- definition

- **Diabetes mellitus** is disease with high glucose level (hyperglycaemia) due to absolute or relative lack of insulin produced in beta cells of Langerhans pancreatic islets

Diabetes mellitus- classification

- Diabetes type 1
- Diabetes type 2
- Gestational diabetes

Epidemiology of diabetes (CZ in 2009)

- 800 000
- 8% of population

- DM type 1	8%
- DM type 2	92%

Pathogenesis of diabetes type 1

- The destruction of insulin-producing beta-cells of pancreatic islets of Langerhans

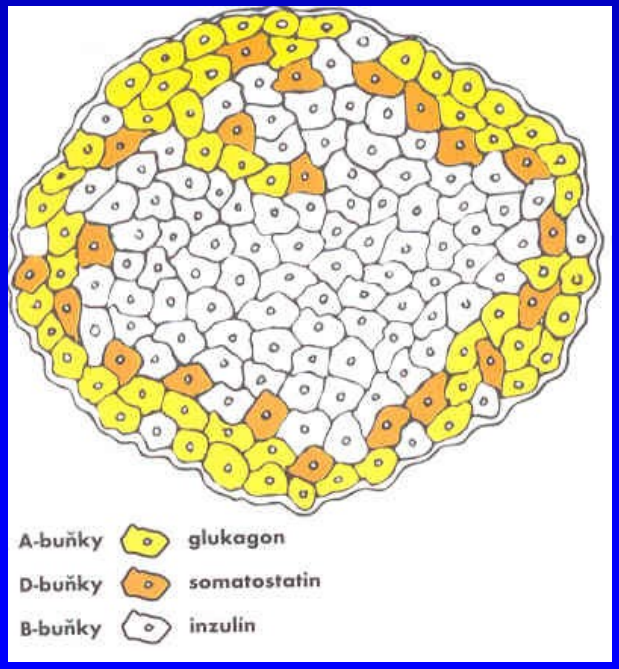
  (autoimmune process, a genetic predisposition, external environmental factor, in the second of identical twins diabetes arises only in 50% of cases)

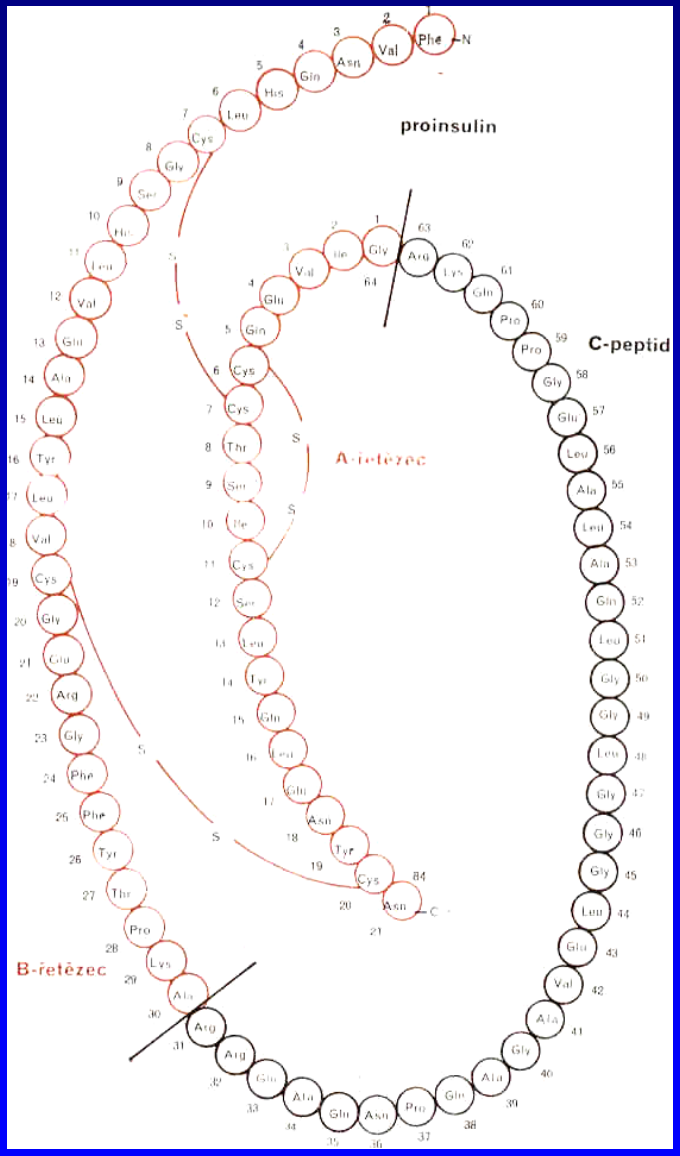
Pathogenesis of diabetes type 2

- Failure of insulin secretion in pancreatic beta-cells
  Reduction of insulin action in target tissues (insulin resistance)

Insulin

discovered 1921 (Banting, Best, Macleod, Collip)





Diabetes mellitus (acute complications)

- hyperglycaemic ketoacidotic coma
  hyperglycaemic hyperosmolar coma
  lactacidotic coma
  hypoglycaemic coma

Diabetes mellitus (late complications)

1. retinopathy
2. nephropathy
3. diabetic foot
4. neuropathy

Diabetes mellitus (therapy)

- Education
- Diet
- Oral antidiabetics
- Insulin

Diabetic retinopathy (definition)

- **Diabetic retinopathy** is **microangiopathy**, ie. retinal vascular impairment in diabetic patients

Diabetic retinopathy (history)

- DM first description– Ebers papyrus (1550 before Ch.), Aretaios from Kappadokia (2th century)
- DR was first described after Helmholtz ophthalmoscope discovery (1851)
- First description of DR – Jäger (1851), Desmarres (1855), von Gräfe (1858)
- First classification of DR – Ballantyn a Löwensteine (1943), nonproliferative and proliferative DR

Diabetic retinopathy (history)

- First retinal fotocoagulation– Meyer-Schwickerath (1945), solar photocoagulator (heliostat)
- Regression of proliferative DR after postpartual hypophysal necrosis (1953) – Simmonds- Sheehan syndrome
- Discovery of fluorescence angiography – Novotny, Alvis (1959)

Diabetic retinopathy (history)

- First use of laser– Meyer-Schwickerath (1955-1958), xenon lamp
- Rubine laser (1960)
- Argon laser (1968)
- Pars plana vitrectomy – Machemer, Parel (1970)
- Fluorophotometry – Cunha-Vaz (1975), preretinopathy

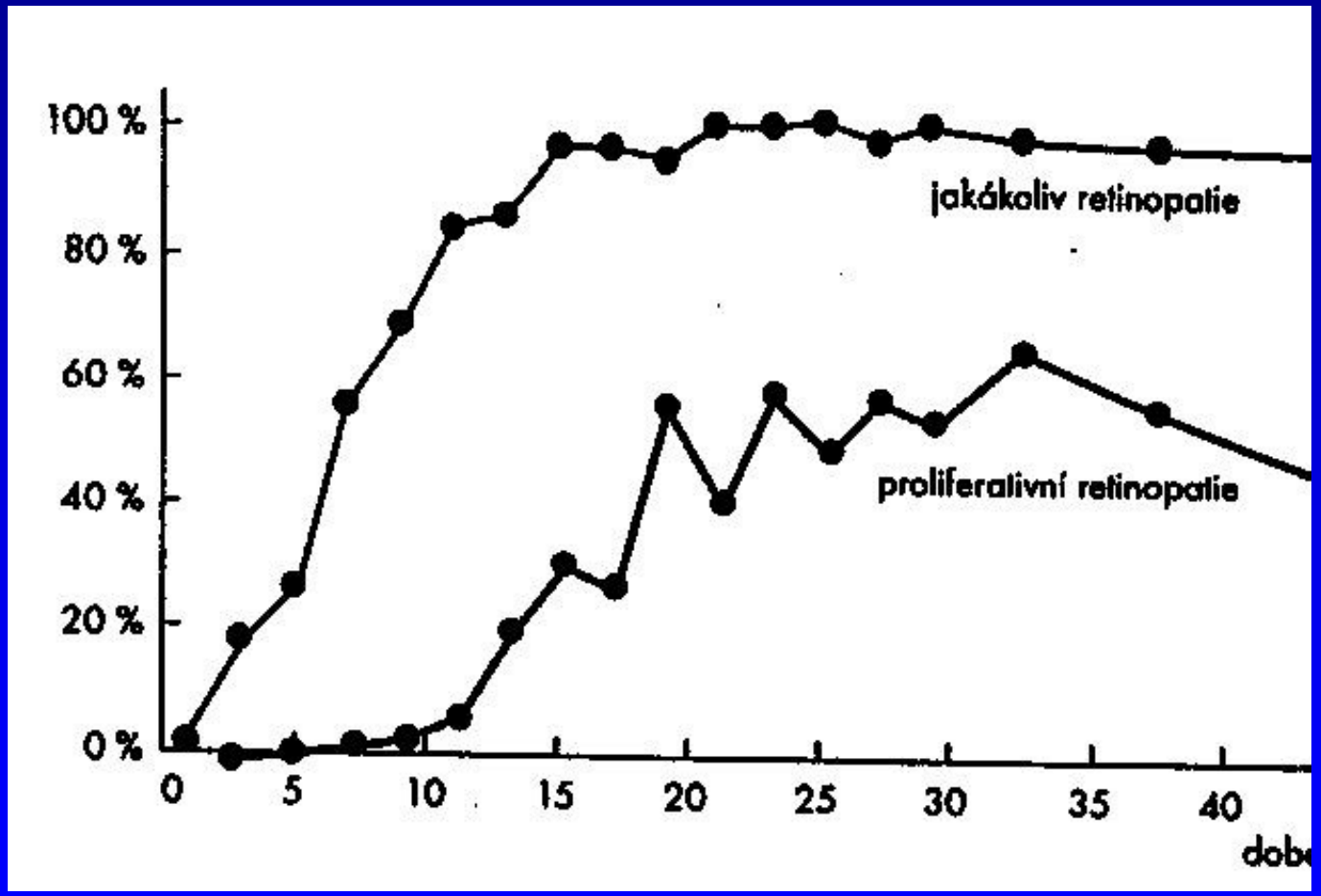
Diabetická retinopatie (historie)

- 1976- **Diabetic Retinopathy Study** (DRS)- laser reduces risk of blidness in proliferative DR
- 1985- **Early Treatment Diabetic Retinopathy Study** (ETDRS)- focal laser photocoagulation reduces risc of visual acuity lost in diabetic macular edema

Diabetic retinopathy (epidemiology)

- Diabetes mellitus- 8% population
- 25% diabetics - DR
- 5% diabetics - proliferative DR
- DR rare until first 3-5 years of duration of DM
- DR in 60- 90% after 15- 20 years of duration of DM
- DR in 97% after 30 years of duration of DM

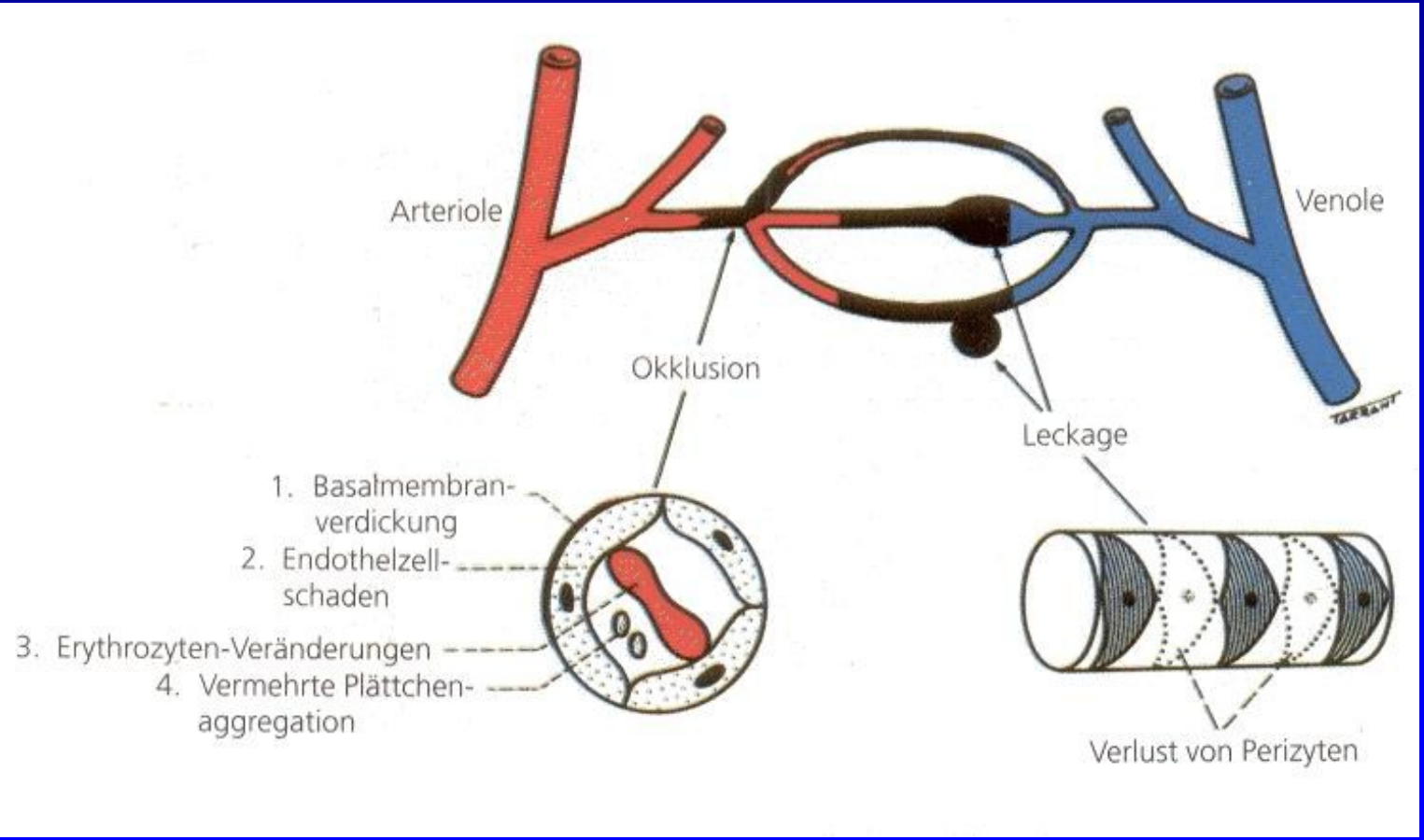
Patophysiology of diabetic retinopathy



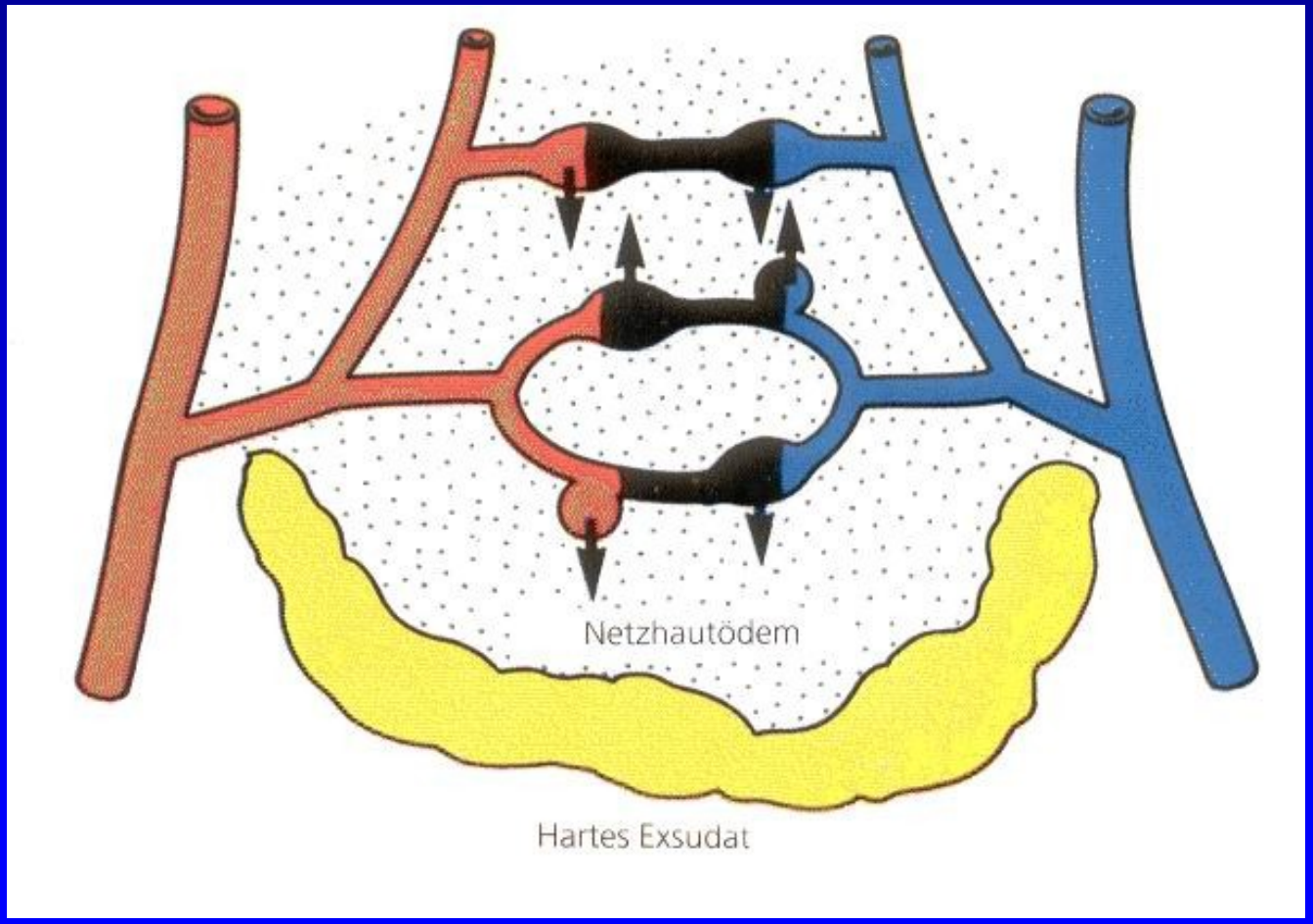
Patophysiology of diabetic retinopathy

- Microangiopathy
- Lost of endothelial cells and pericites
- Thickening of basal membrane of retinal capillaries (glycoproteins)
- Failure of outer and inner blood retinal barrier

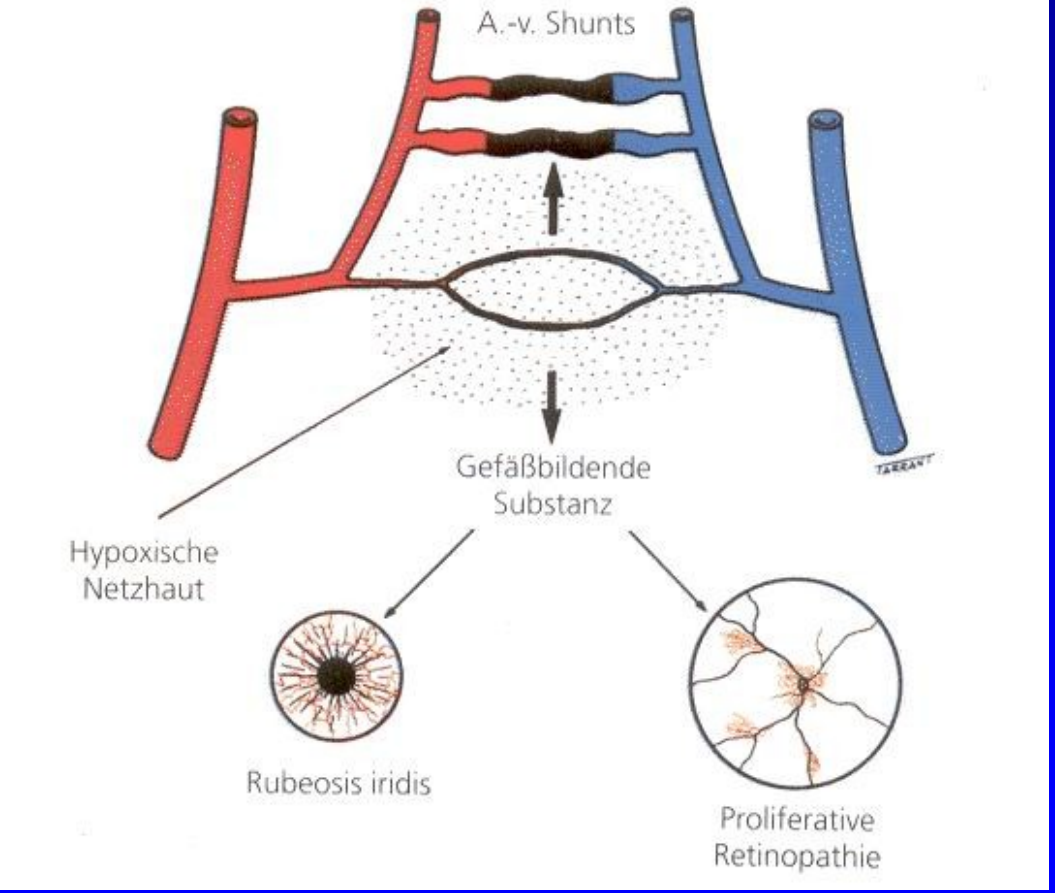
Patophysiology of diabetic retinopathy



Patophysiology of diabetic retinopathy



Patophysiology of diabetic retinopathy



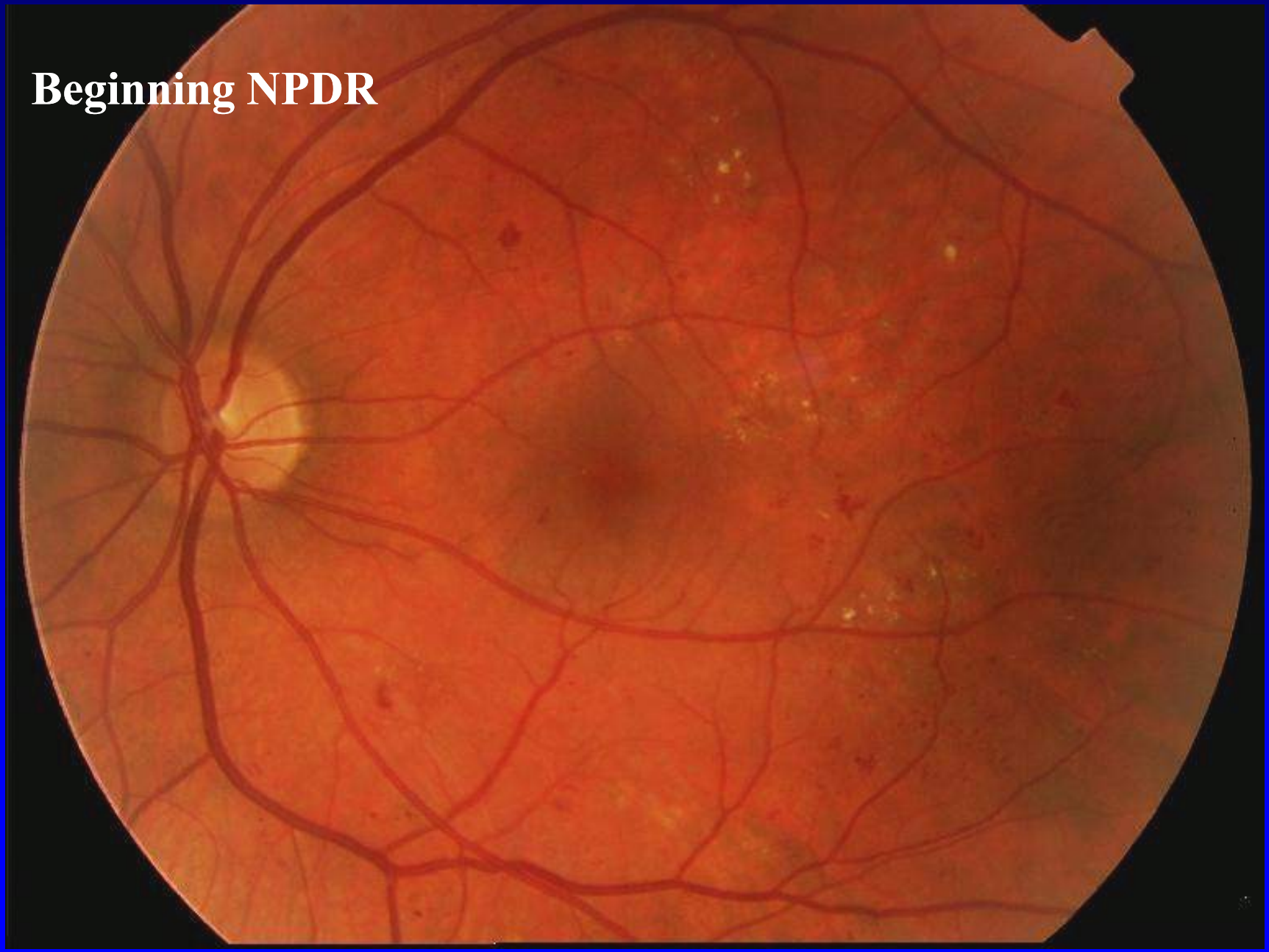
Classification of diabetic retinopathy

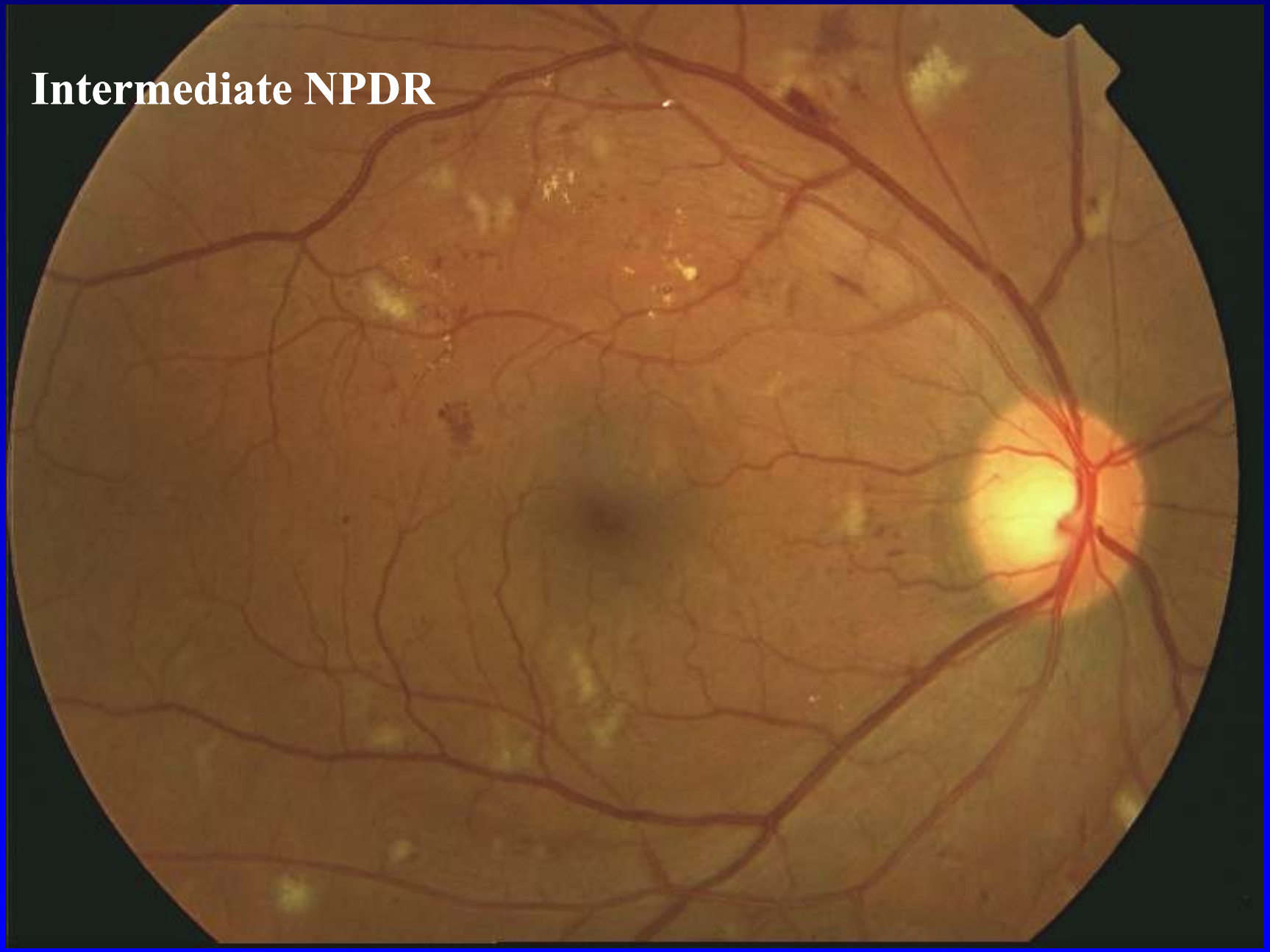
1. **Nonproliferative DR** (NPDR)
2. **Proliferative DR** (PDR)
3. **Diabetic maculopathy** (M)

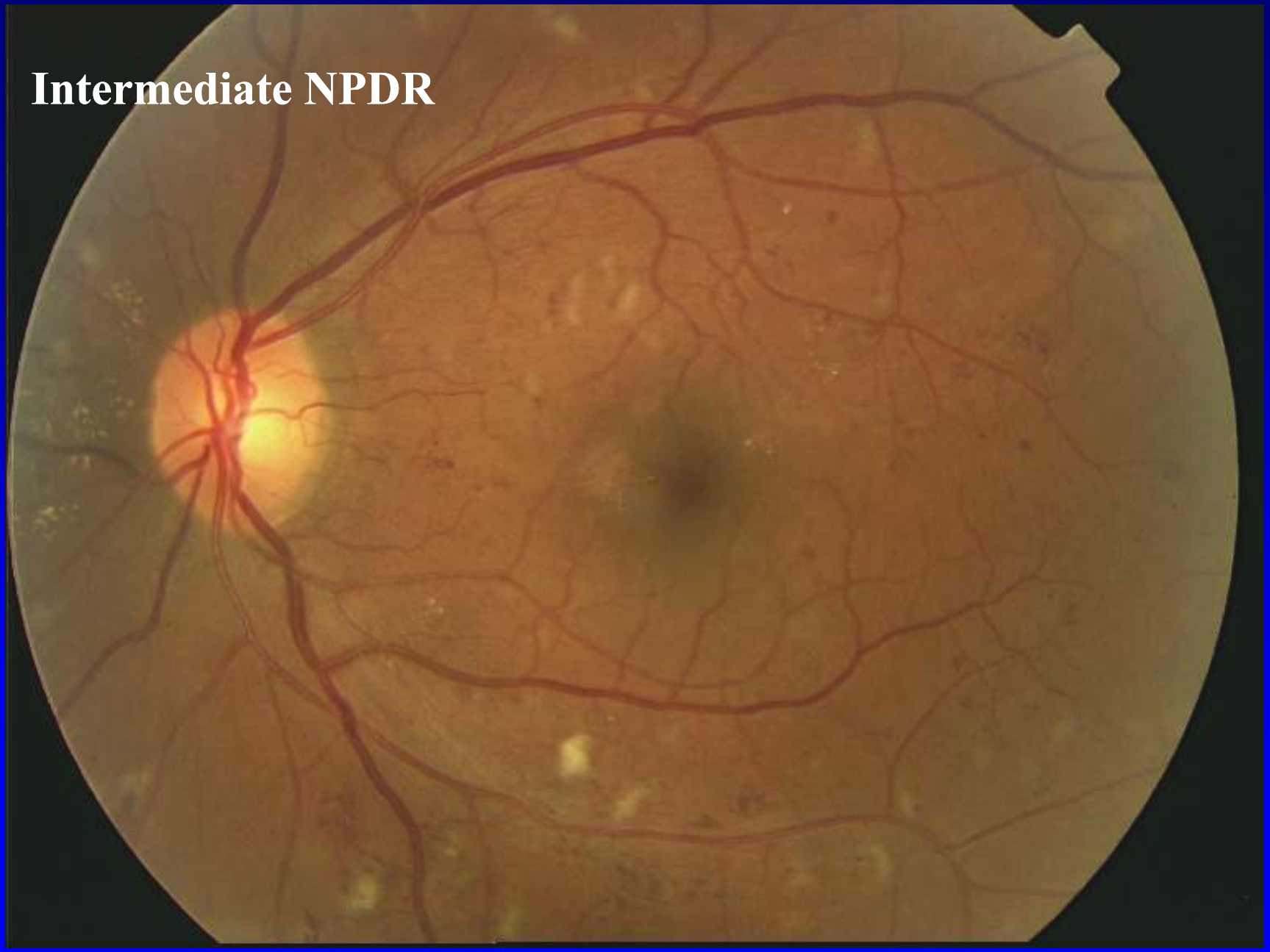
(each level of diabetic retinopathy may or may not beaccompanied by diabetic maculopathy)

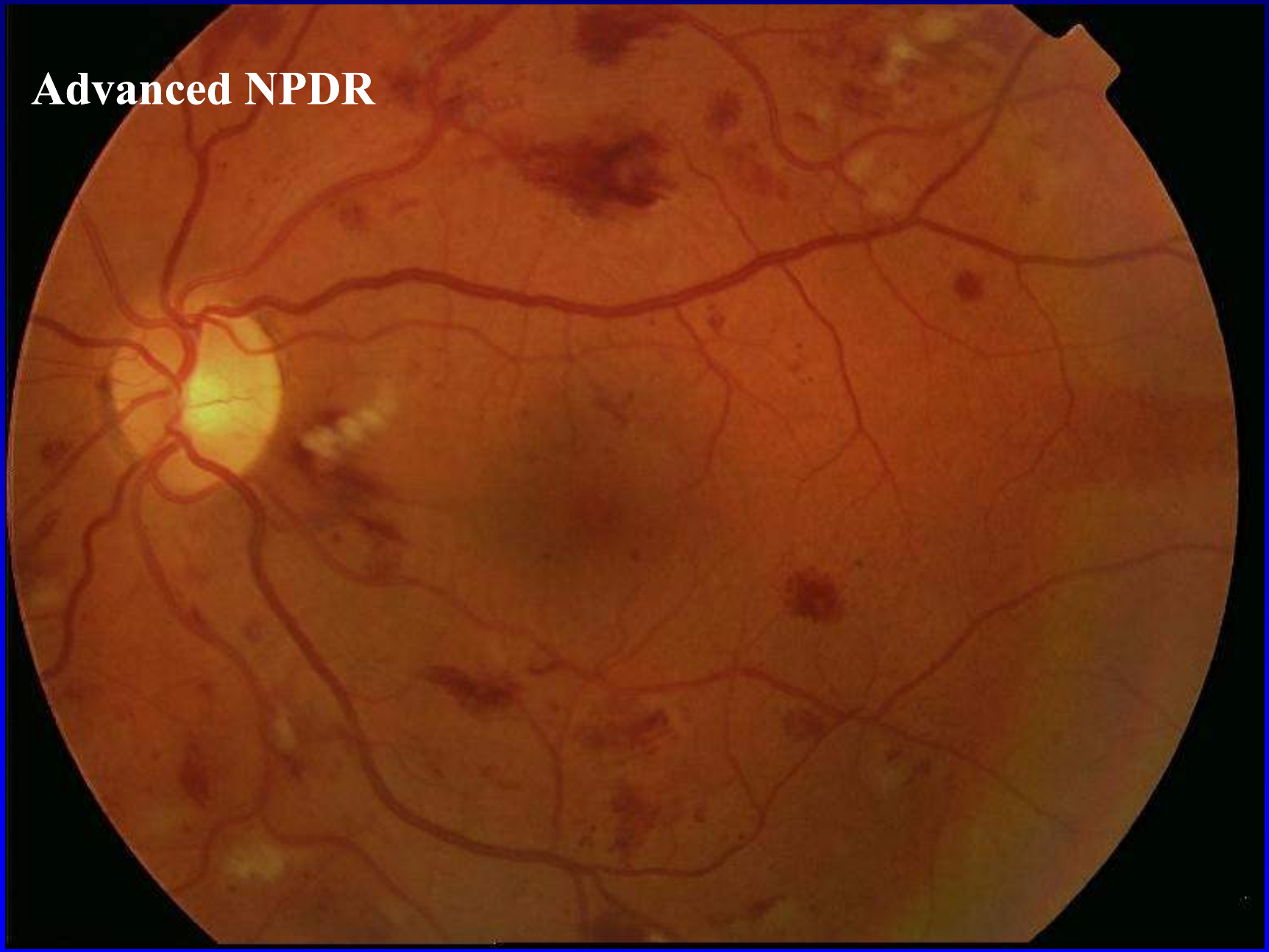
Nonproliferative DR (NPDR)

- **Beginning**
- **Intermediate**
- **Advanced**


Beginning NPDR


Intermediate NPDR


Intermediate NPDR

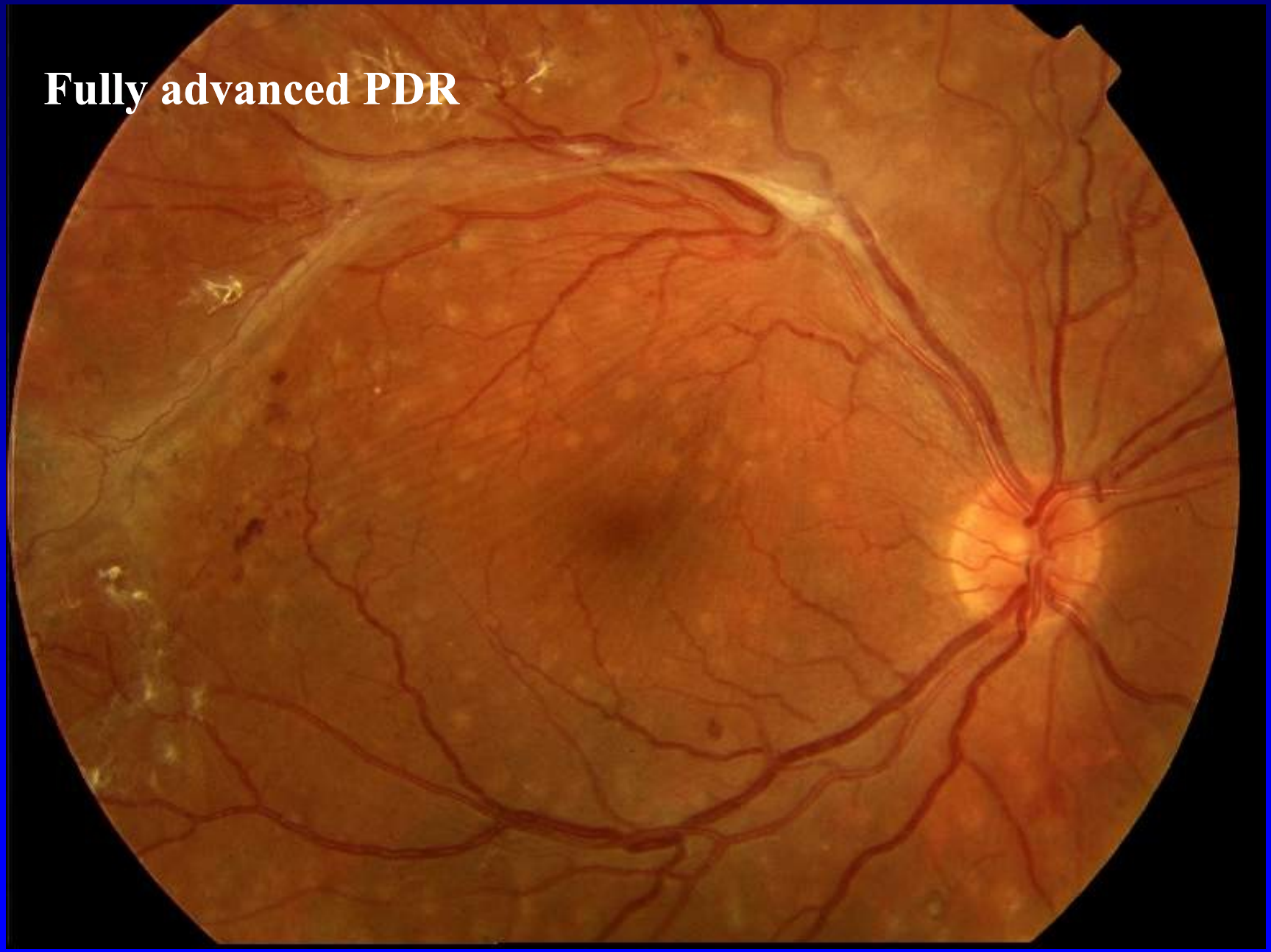

Advanced NPDR

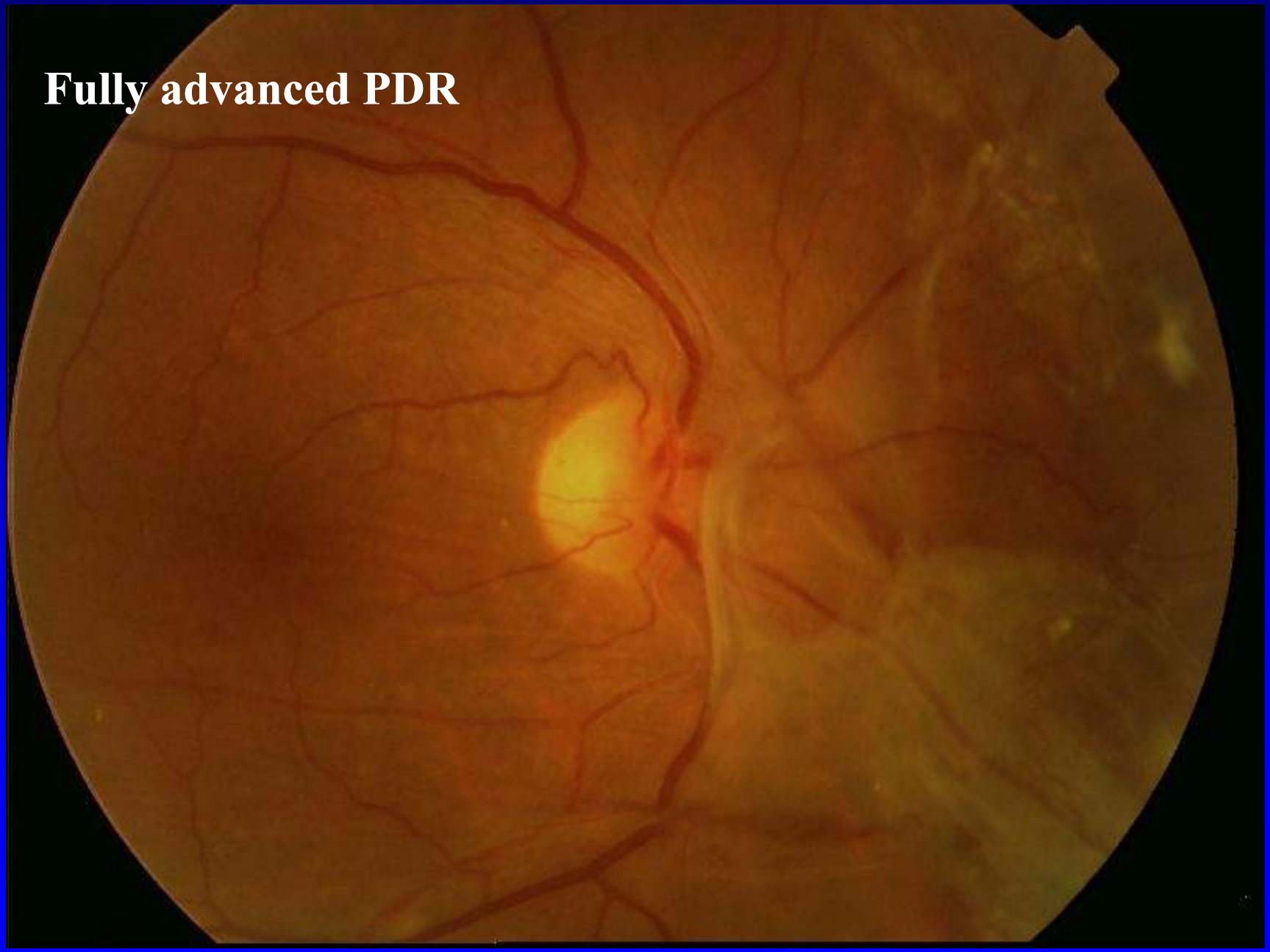
Proliferative DR (PDR)

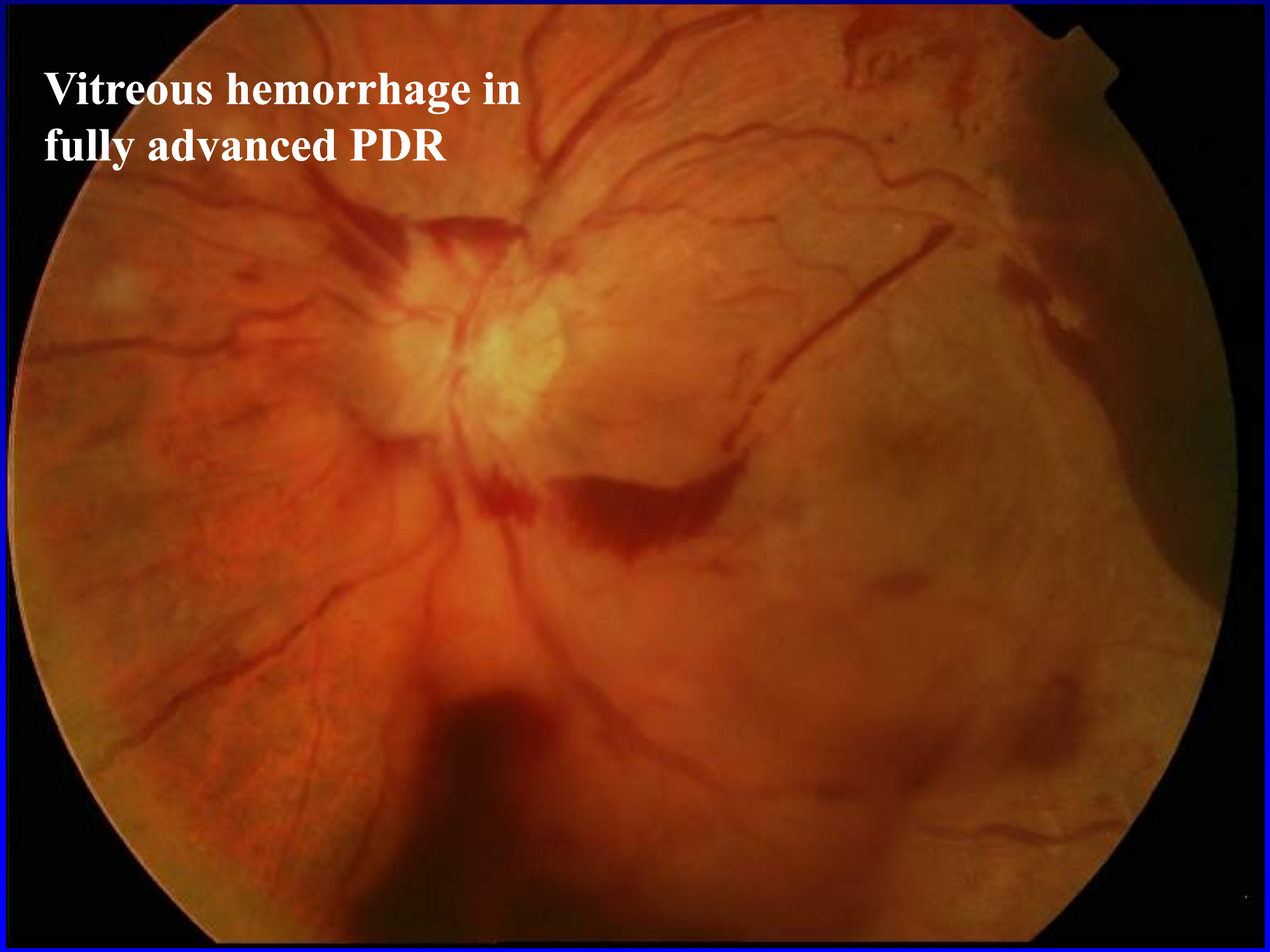
- **Light**
- **Intermediate**
- **Fully advanced** VH- vitreous hemorrhage, PRH- preretinal hemorhage, TRD- retinal detachment at center of macula


Light PDR


Intermediate PDR


Fully advanced PDR


Fully advanced PDR


Vitreous hemorrhage in
fully advanced PDR

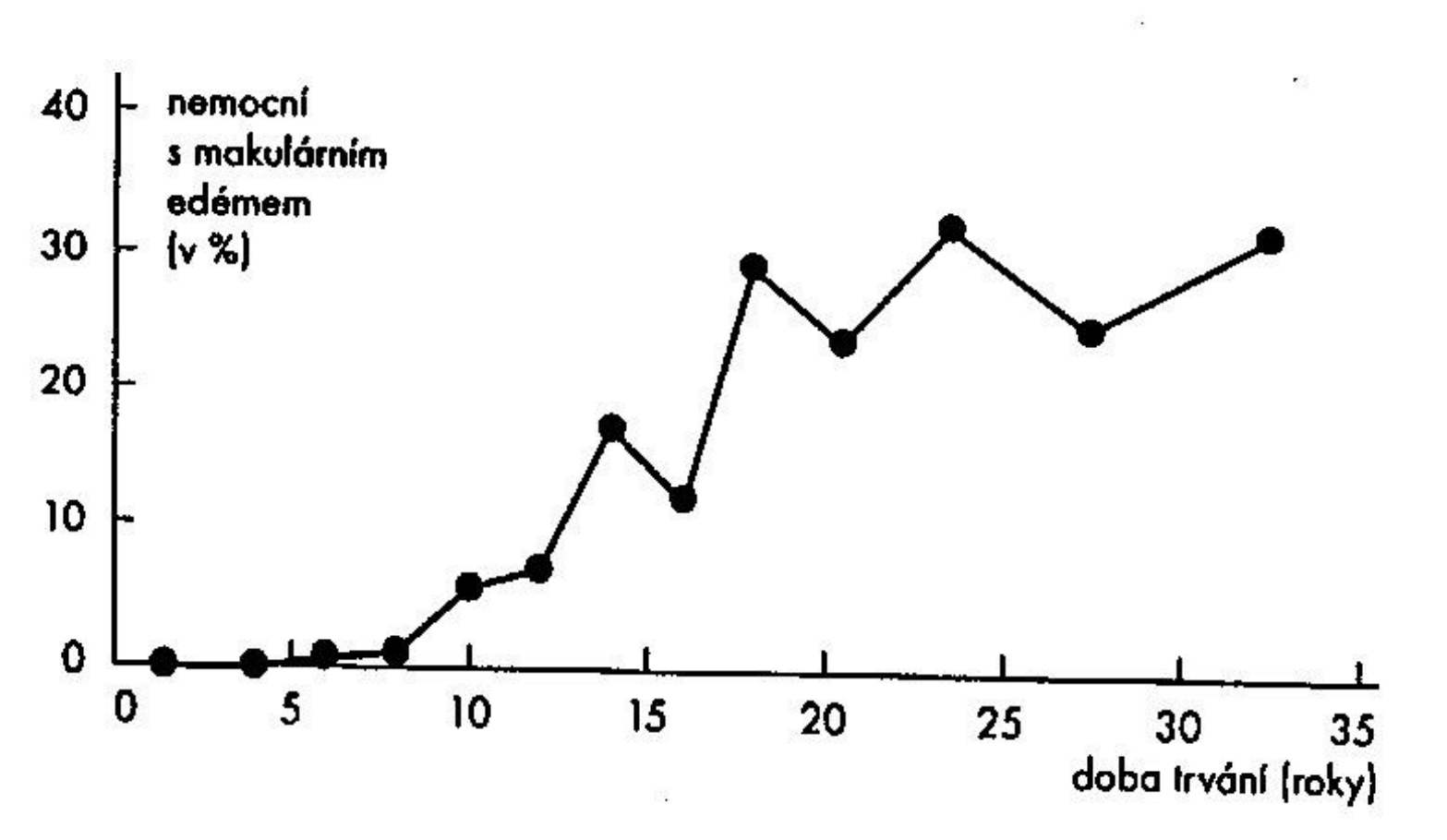
ETDRS Final Retinopathy Severity Scale for Individual Eyes
Bold Type = levels used in change scale

Level	Severity	Definition
10	**DR absent**	Microaneurysms and other characteristics absent
12	Non-DR Abnormalities	
14[a]	DR questionable	14A HE definite; microaneurysms absent
		14B SE definite; microaneurysms absent
		14C IRMA definite; microaneurysms absent
15[a]	DR questionable	Hemorrhage(s) definite; microaneurysms absent
20	**Microaneurysms only**	Microaneurysms definite; other characteristics absent
35[b]	**Mild NPDR**	35A Venous loops ≥D/1
		35B SE, IRMA, or VB = Q
		35C Retinal Hemorrhages present
		35D HE ≥D/1
		35E HE ≥M/1
		35F SE ≥D/1
43	**Moderate NPDR**	43A H/Ma = M/4-5 or S/1
		43B IRMA = D/1-3
47	**Moderately severe NPDR**	47A Both Level 43 characteristics
		47B IRMA = D/4-5
		47C H/Ma = S/2-3
		47D VB = D/1
53	**Severe NPDR**	***53A ≥2 of the 3 Level 47 characteristics***
		53B H/Ma ≥S/4-5
		53C IRMA ≥M/1
		53D VB ≥D/2-3
	53E Very Severe NPDR	***53E ≥2 of 53B, 53C, and 53D***
61	**Mild PDR**	61A FPD and/or FPE only (regressed PDR)
		61B NVE <½ disc area in ≥1 field
65	**Moderate PDR**	65A NVE ≥M/1 (≥½ disc area in ≥1 field)
		65B NVD = D and VH or PRH = A or Q
		65C VH or PRH = D and NVE <M/1 and NVD absent
71	**High-risk PDR**	71A VH or PRH ≥M/1 (M = about 1 disc area)
		71B NVE ≥M/1 and VH or PRH ≥D/1
		71C NVD = D and VH or PRH ≥D/1
		71D NVD ≥M
75	**High-risk PDR**	75 NVD ≥M and VH or PRH ≥D/1
81	Advanced PDR: Fundus partially obscured, center of macula attached	NVD = cannot grade, or NVD <D and NVE = cannot grade in ≥1 field and absent in all others; and retinal detachment at center of macula <D
85	Advanced PDR: Posterior fundus obscured, or center of macula detached	85A VH = VS in Field 1 or 2 85B Retinal detachment at center of macula = D
90	Cannot grade, even sufficiently for level 81 or 85	

Diabetic maculopathy (M)

- affects 33% of diabetic patients after 8-10 years of duration of disease
- the most common cause of vision loss in diabetic retinopathy

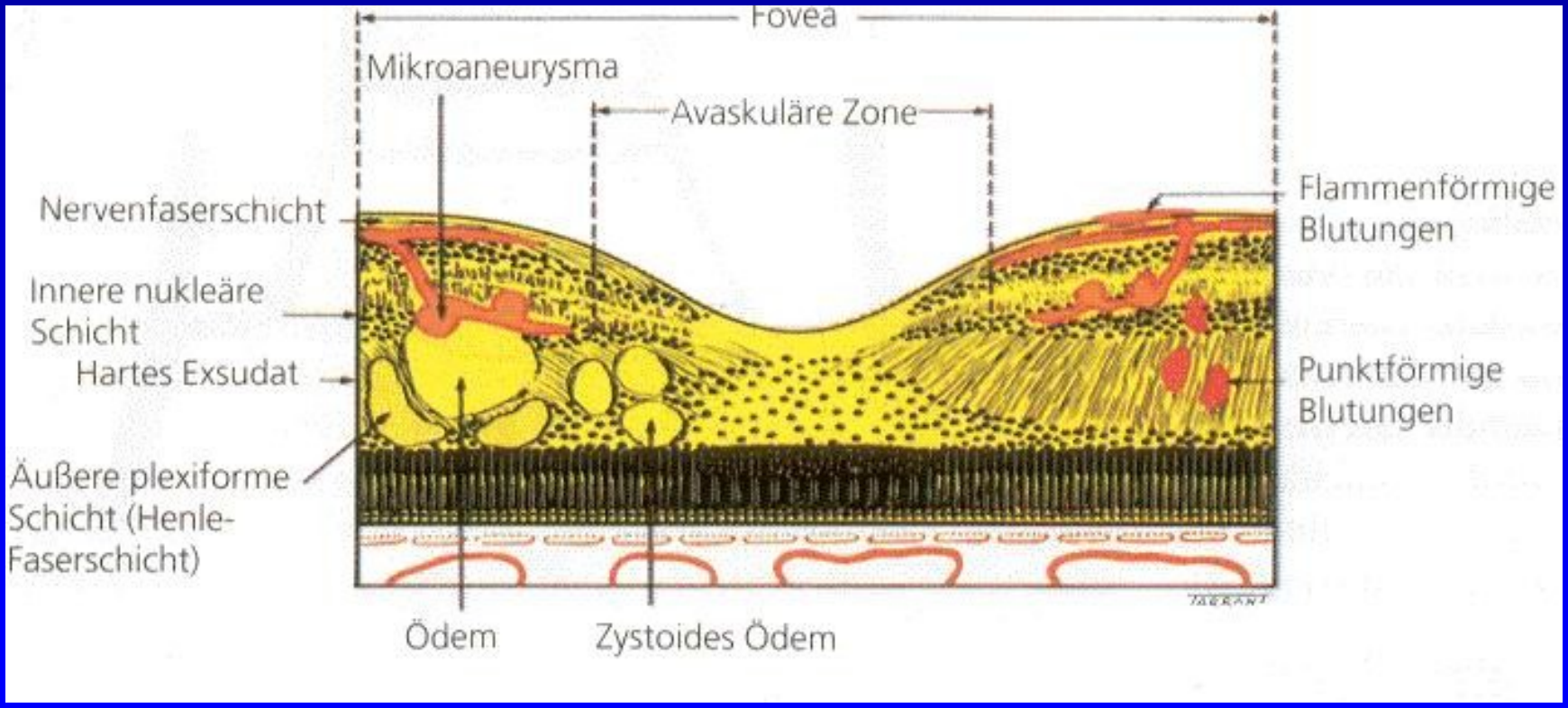
Diabetic makulopathy (M)



Diabetic makulopathy (M)

- Macular area is a predilection site for edema formation
  Microangiopathy leads to ischemia, fluid accumulation, formation of microcysts and cysts
  Hard exudates (lipid accumulation) occur on the boundary of ischemic and normal retina

Diabetic makulopathy (M)



Diabetic makulopathy (classification)

- **Focal edema**
- **Difuse edema**
- **Ischemic edema** (rare)- avascular zone in macula


Focal edema


Difuse edema


Ischemic edema

Therapy of diabetic retinopathy and maculopathy

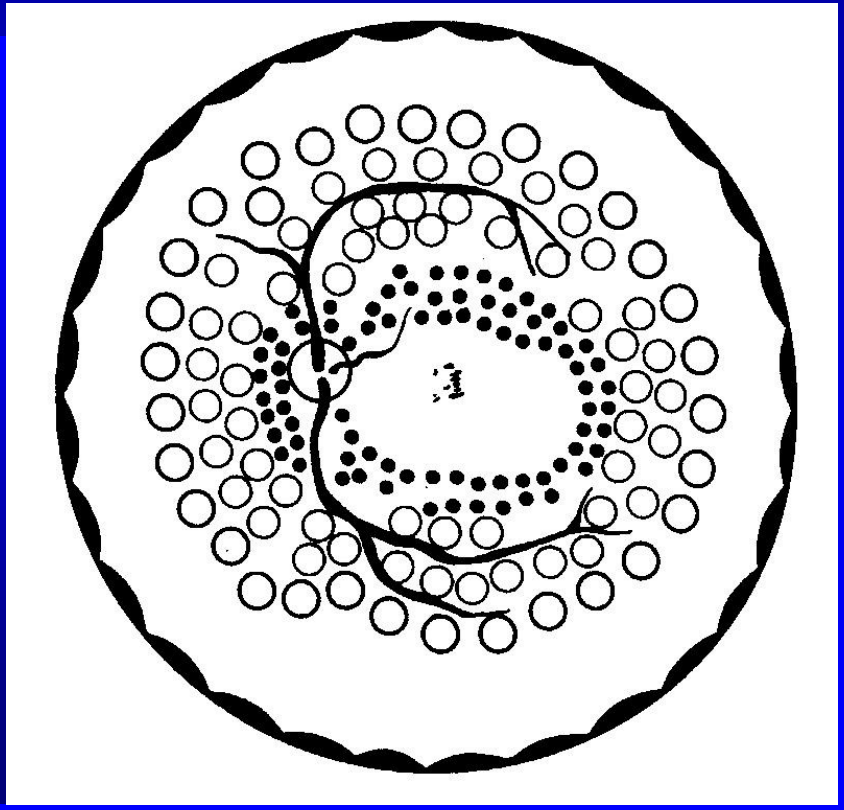
- Gold standard is laser photocoagulation of ischemic retinal parts
- Laser can‘t be performed in central macular zone

Laser therapy (technique)

- Laser therapy of DR

1. focal

2. panretinal (scatter)

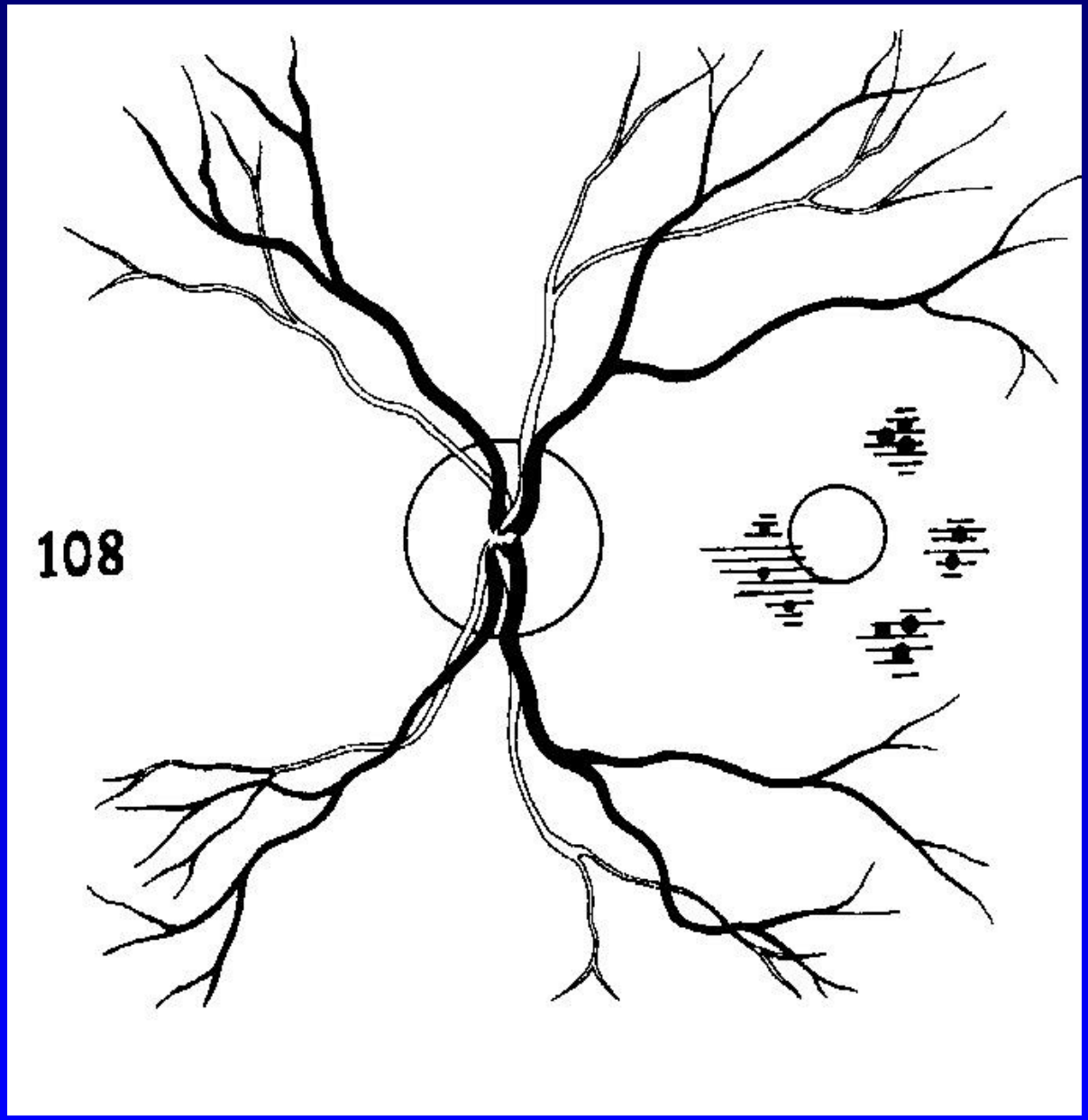



Laser spots in retina
suffered from NPDR

Laser therapy (technique)

- Laser therapy of diabetic maculopathy

1. focal
2. grid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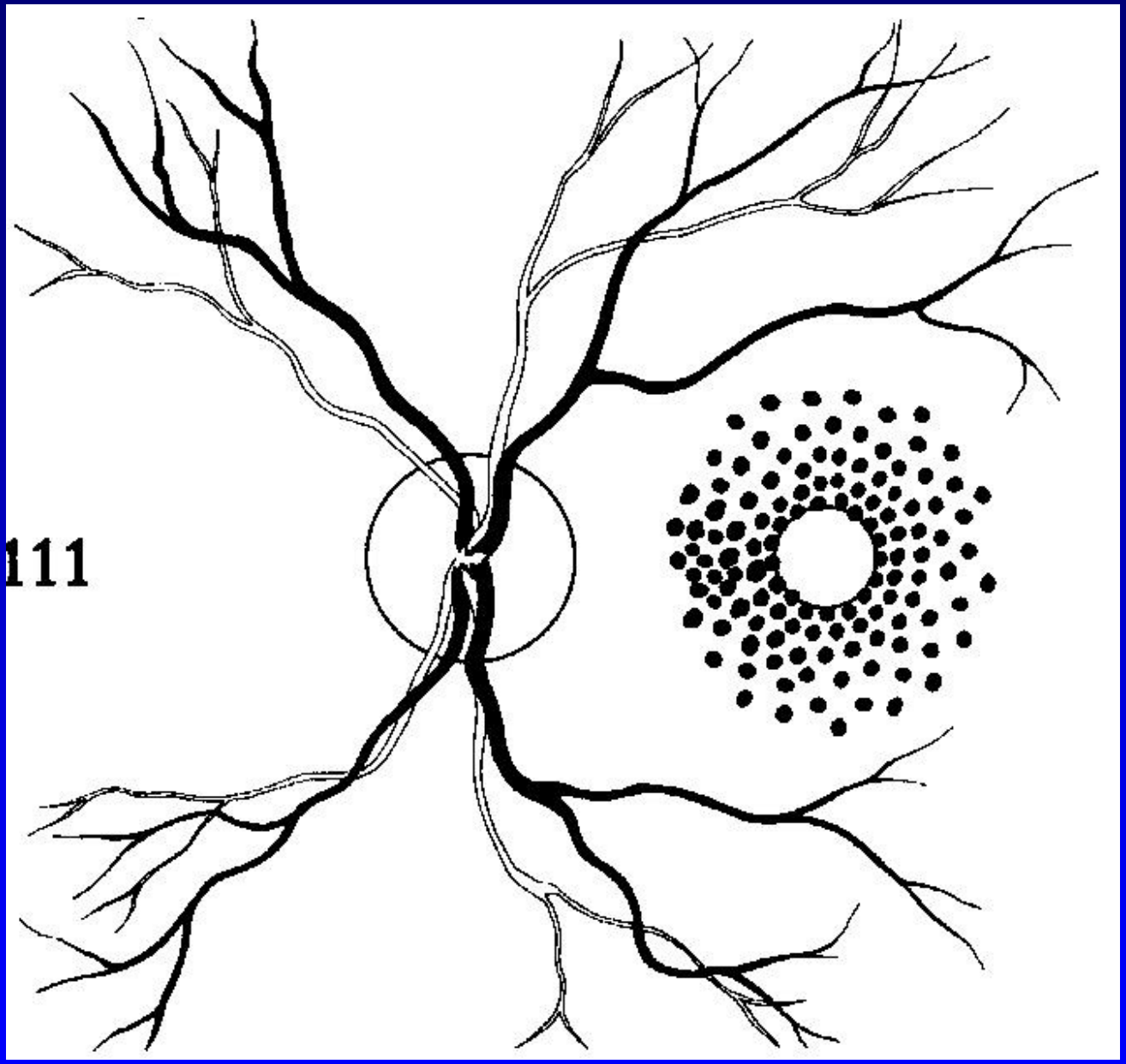
Focal laser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Grid laser

Laser therapy (positives)

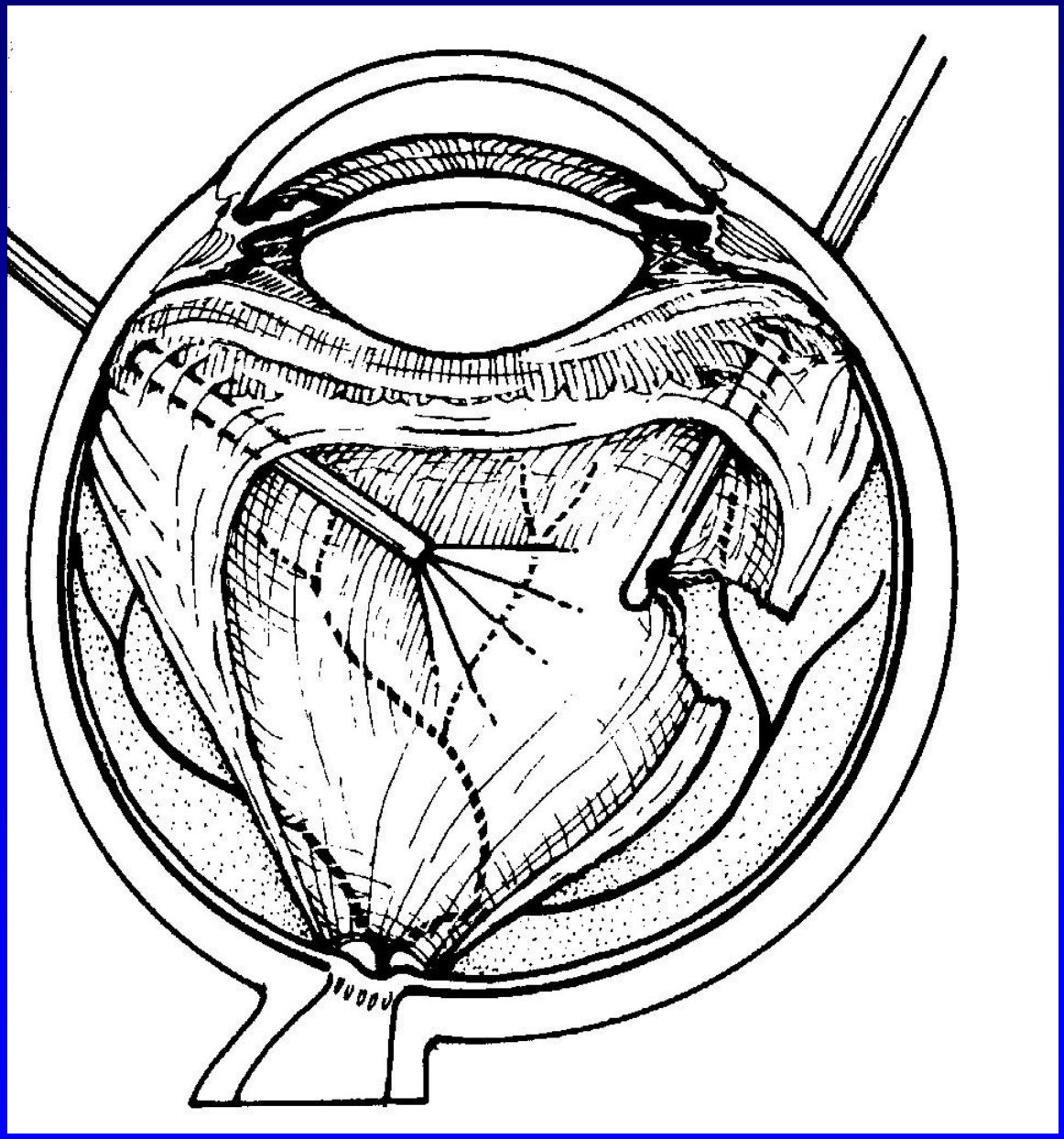
- Reducing of risc of visual loss
- Reducing of risc of vitreous hemorrhage, neovascular glaucoma and tractional retinal detachment

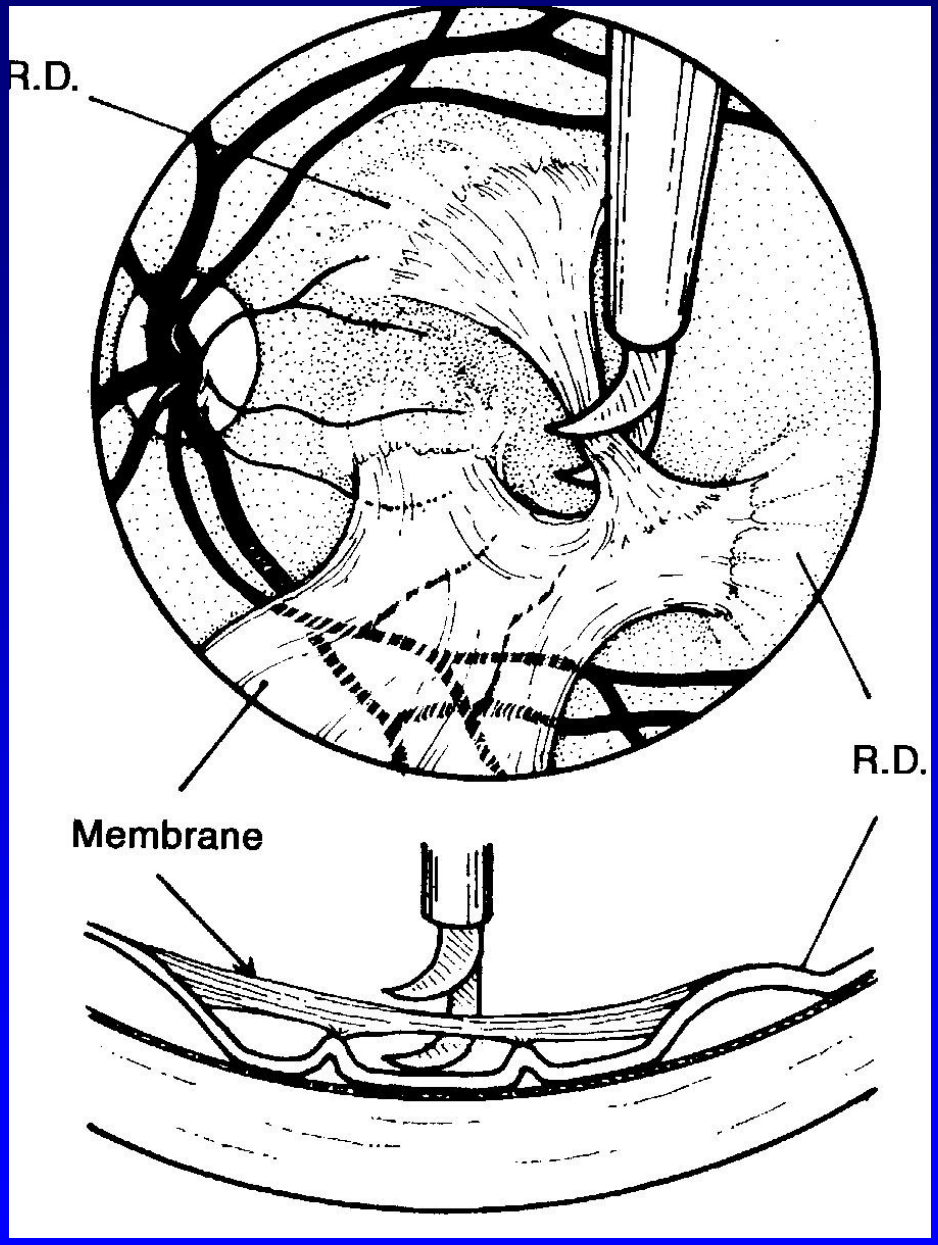
Laser therapy (negatives)

- Paliative treatment
- Dark adaptation problems

Surgical therapy of DR

- Pars plana vitrectomy- (Machemer, Parel – 1970)




R.D.
R.D.
Membrane