FUNDUS FLUORESENCIN ANGIOGRAPHY

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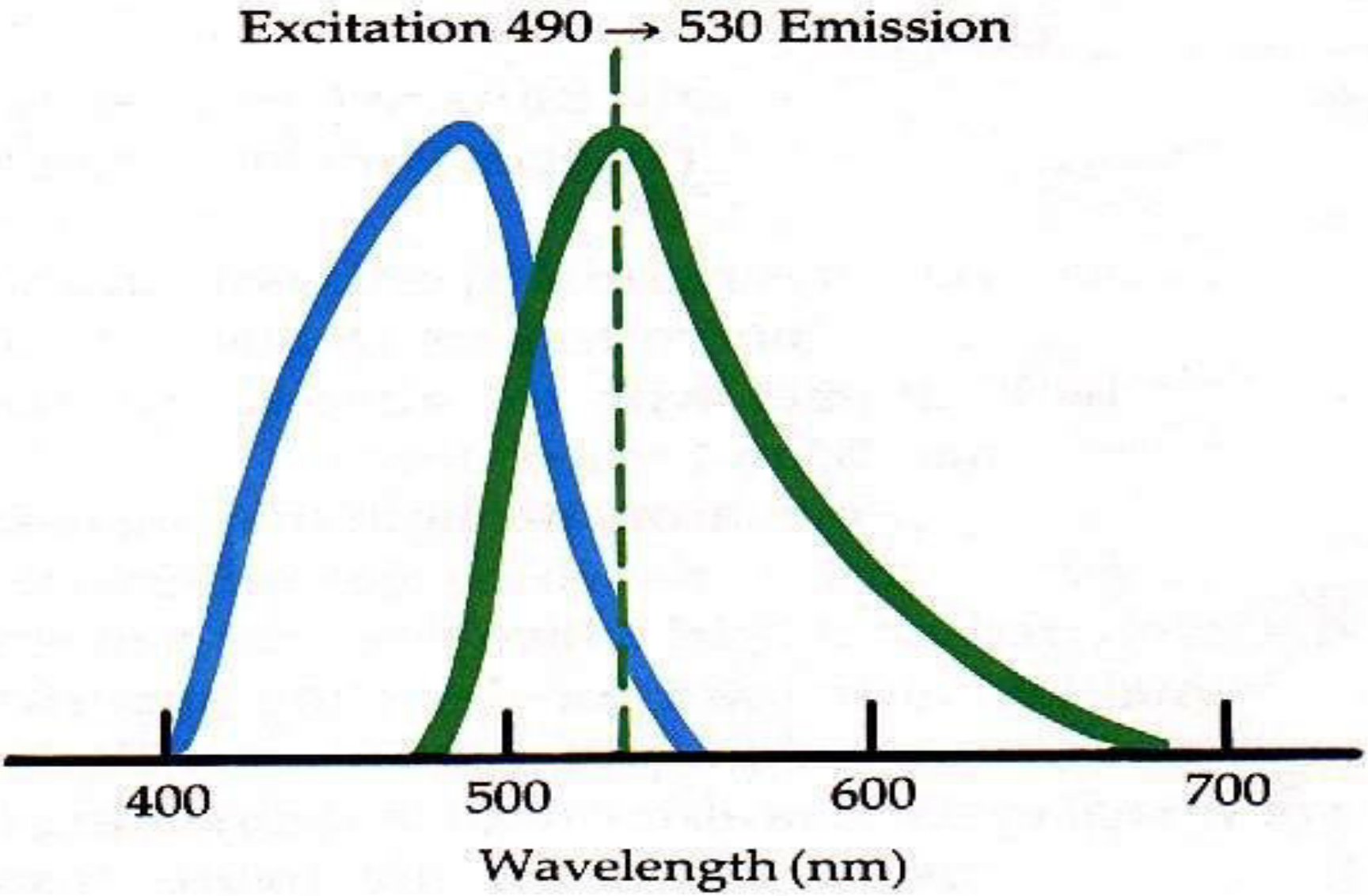
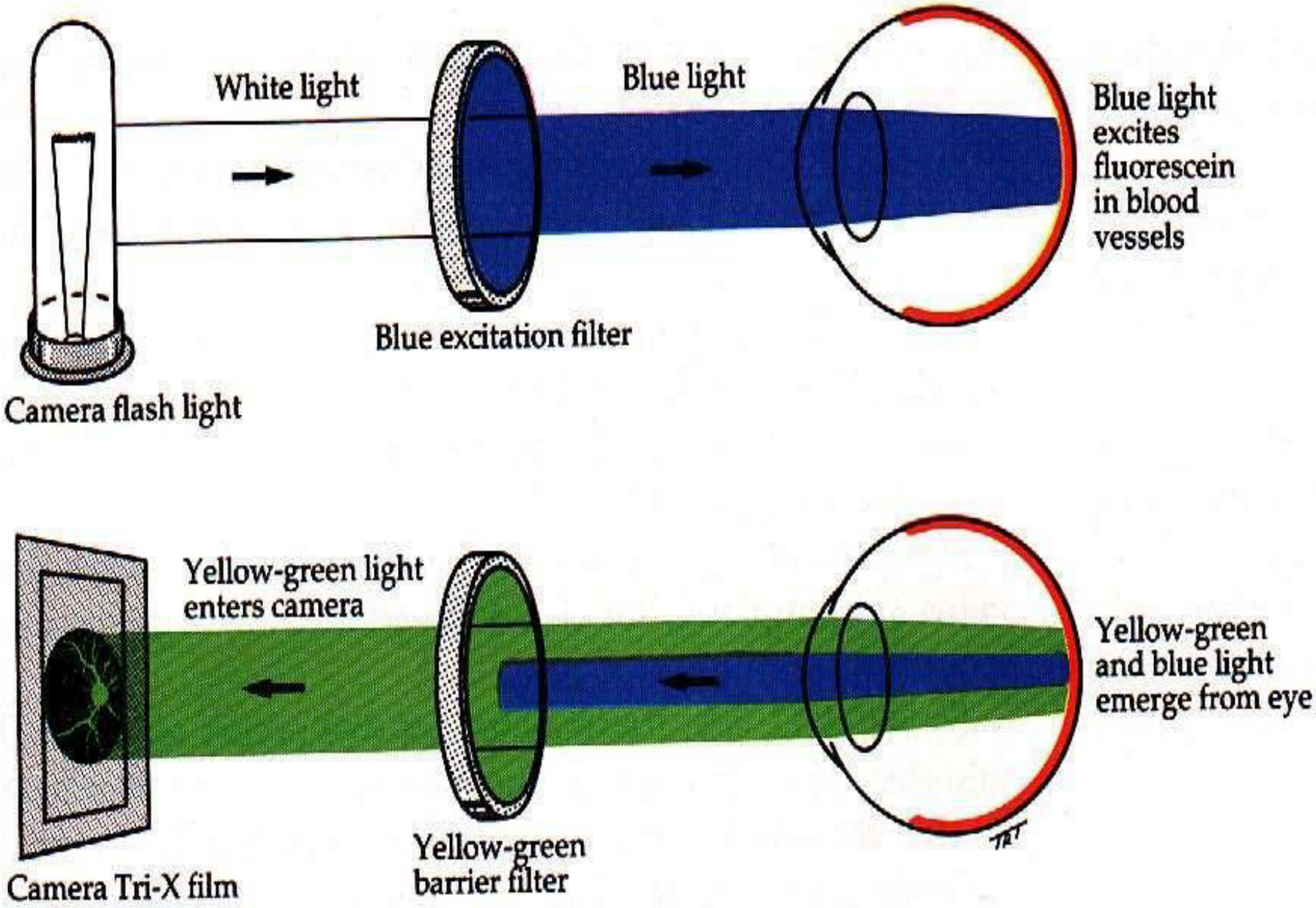
Principle

- ***FLUORESCENCE*** :- Property of the certain molecules to emit light energy of longer wave length when stimulated by a shorter wavelength.
- Absorbs light in the blue range peaking at **465-490 nm**
- Emits light of yellow-green range of visible spectrum peaking at **520-530nm.**

EXCITATION AND EMISSION




White light
Blue light
Blue light excites fluorescein in blood vessels
Blue excitation filter
Camera flash light
Yellow-green light enters camera
Yellow-green and blue light emerge from eye
Yellow-green barrier filter
Camera Tri-X film

sodium fluorescein

- Fluorescein(sodium fluorescein) is an orange water-soluble dye that, when injected intravenously,
- Remains largely intravascular (>70% bound to serum proteins).
- It is excreted in the urine over 24–36 hours.
- FFA involves photographic surveillance of the passage of fluorescein through the retinal and choroidal circulations following intravenous injection.

PROCEDURE

- Patient is informed of the normal procedures, the side effects and the adverse reactions.

- Dilating the pupil
- Made to sit comfortable.
- 3-4 red free photographs taken.(**control photographs**)

- 5ml of 10% or 3ml of 25% fluorescein dye injected through the anticubital vein
- wait for 10 – 12 seconds(normal arm-retina time)
- Photos are taken at 1 second interval for 10 seconds
- Then every 2 seconds interval for 30 seconds
- Late photographs are usually taken after 3 ,5 and 10 minutes

TECHNIQUE

CIRCULATION

Peripheral vein

↓

venous circulation

↓

heart

↓

arterial system

↓

INTERNAL CAROTID ARTERY

↓

Ophthalmic artery

↙ ↘

Short posterior ciliary artery (choroidal circulation)

Central retinal Artery (retinal circulation)

PHASES OF NORMAL ANGIOGRAM

- Prearterial phase (choroidal phase)
- Arterial phase
- Arterio -venous phase
- Venous phase
    - early venous
    - mid venous
    - late venous
- Late phase

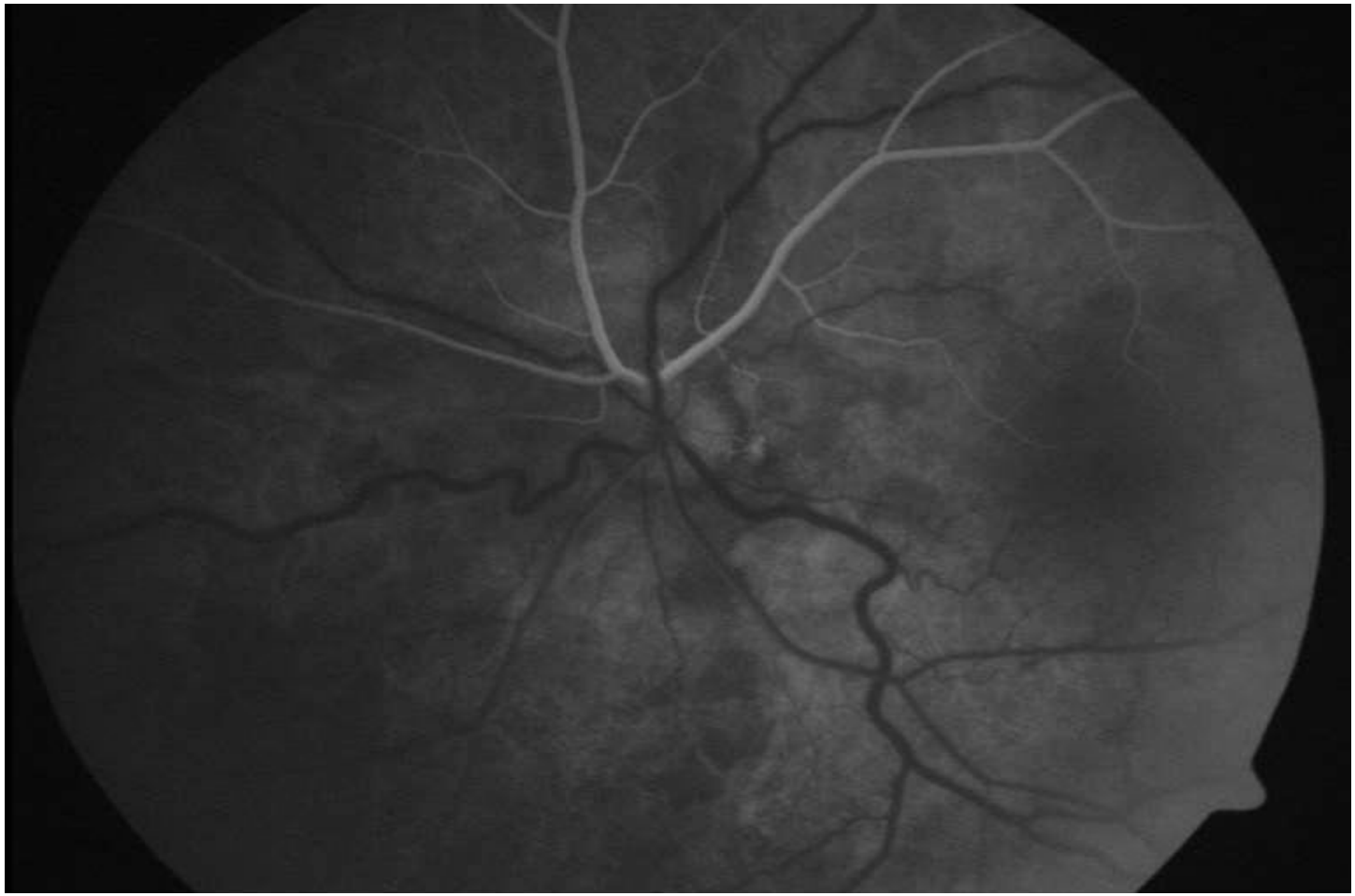
Choroidal phase

- 10 -12 seconds
- Initially patchy filling → diffuse filling → dye leaks from choriocapillaris

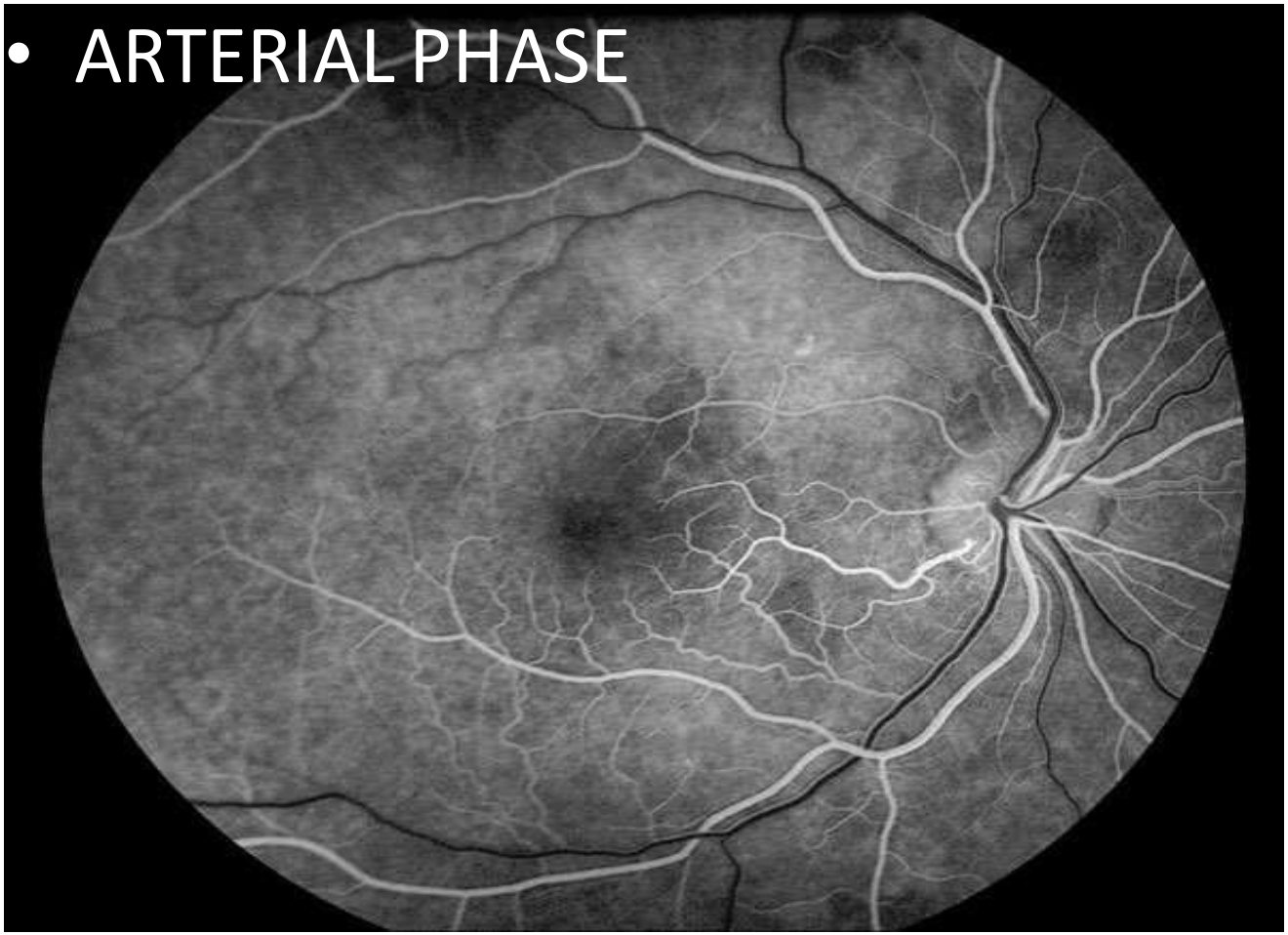
- No dye reaches retinal arteries

- Cilioretinal artery if present fills in this phase

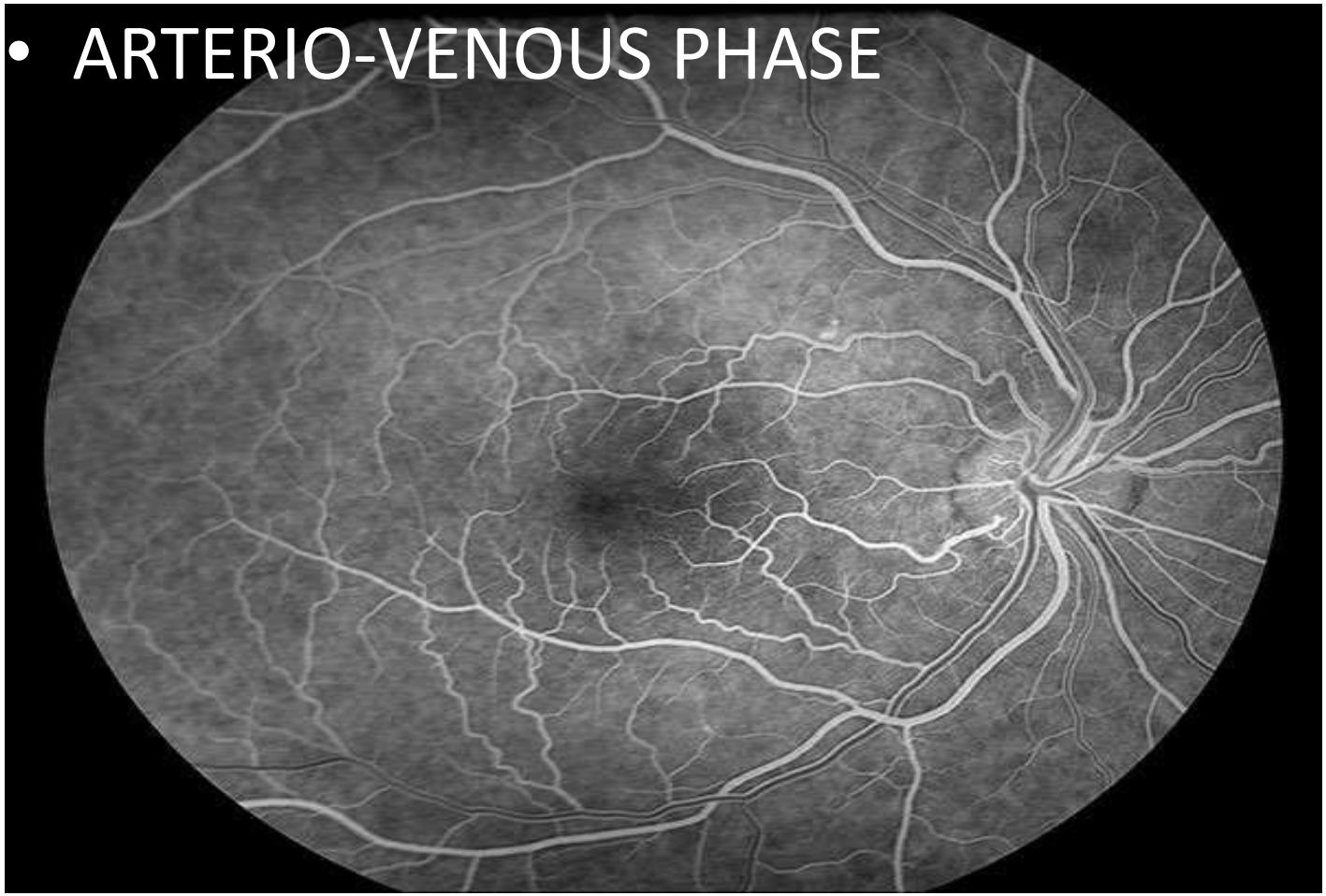
CHORIDAL PHASE



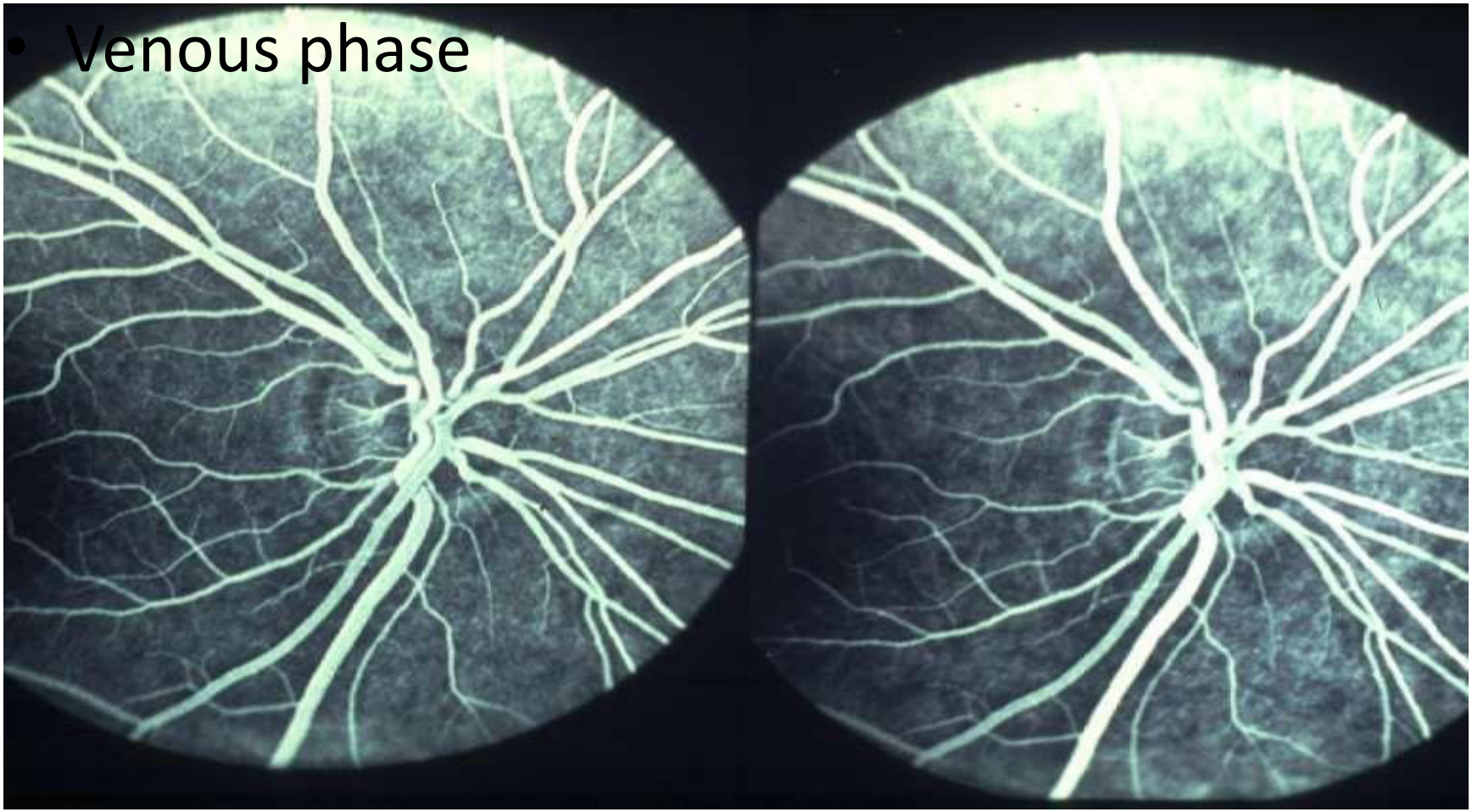
- ARTERIAL PHASE



- ARTERIO-VENOUS PHASE



- Venous phase



Outer blood–retinal barrier

- The major choroidal vessels are impermeable to both bound and free fluorescein.

- However, the walls of the choriocapillaris contain fenestrations through which unbound molecules escape into the extravascular space, crossing Bruch membrane but on reaching the RPE are blocked by intercellular complexes termed tight junctions or zonula occludentes

Inner blood–retinal barrier

- composed principally of the tight junctions between retinal capillary endothelial cells, across which neither bound nor free fluorescein can pass;
- the basement membrane and pericytes play only a minor role in this regard.
- Disruption of the inner blood–retinal barrier permits leakage of both bound and free fluorescein into the extravascular space

Features of FFA

1. Hyperflourescence----an area of abnormally high fluorescence due to increase density of dye molecule
2. Hypoflourescence -----an area of abnormally poor fluorescence

Causes of Hyperflouresence

- ✓Window defect
- ✓Pooling of dye
- ✓Leakage of dye
- ✓Staining of dye

WINDOW DEFECT

- Caused by atrophy or absence of the RPE
- e.g
  - AMD
  - Full thickness macular hole
  - RPE tears
  - Drusen

POOLING

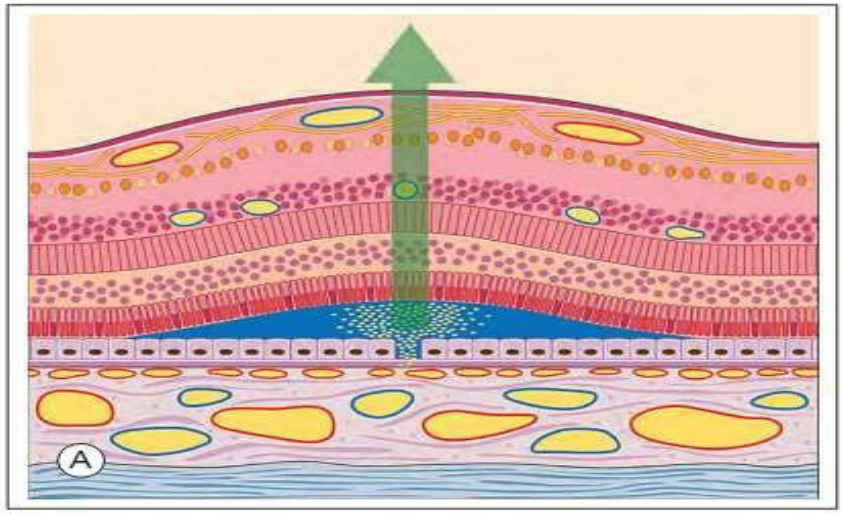
- Accumulation of dye in closed space

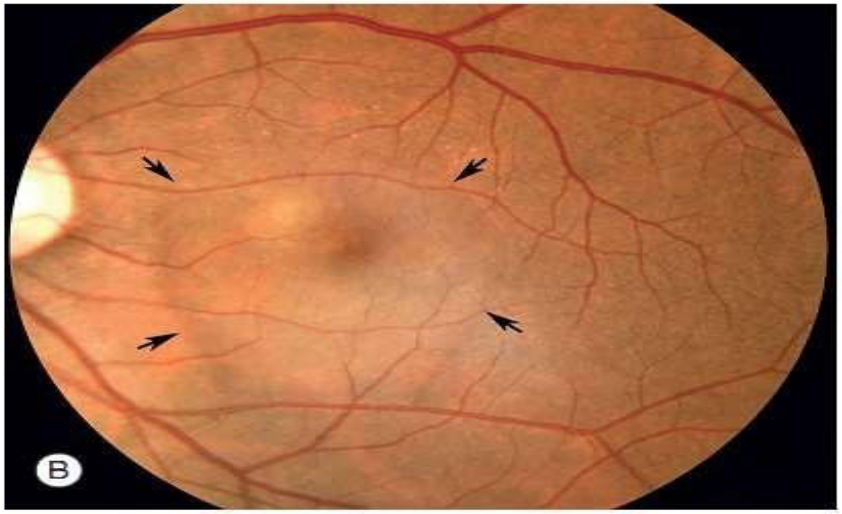
- e.g.

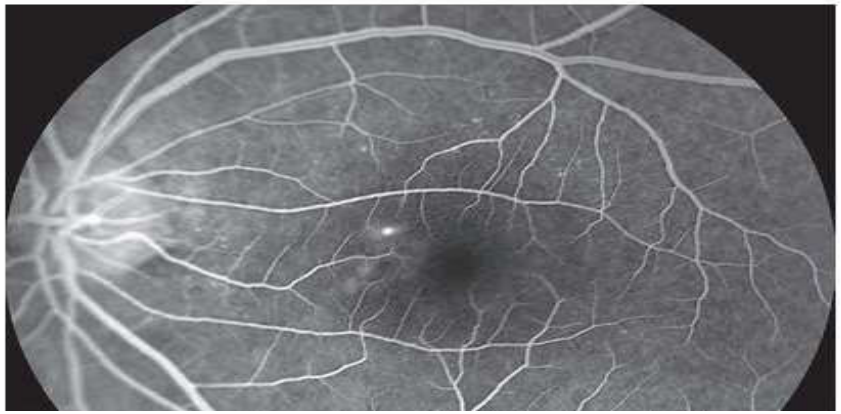
  RPE detachment,

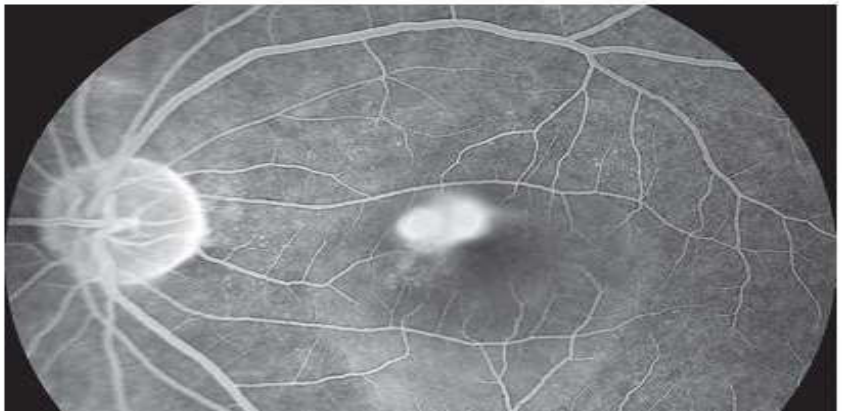
  CSR

CENTRAL SEROUS CHORIORETINOPATHY(CSR)

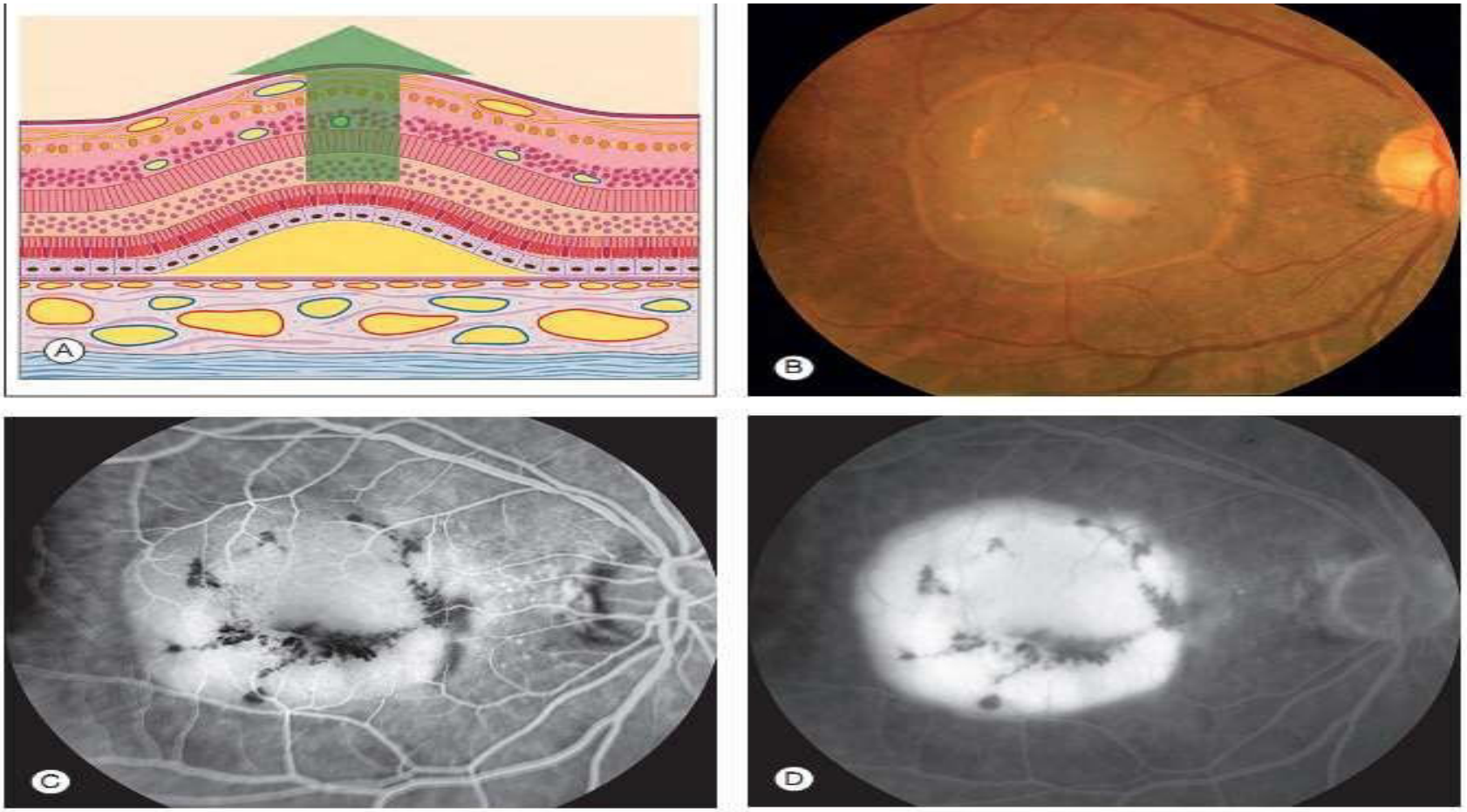








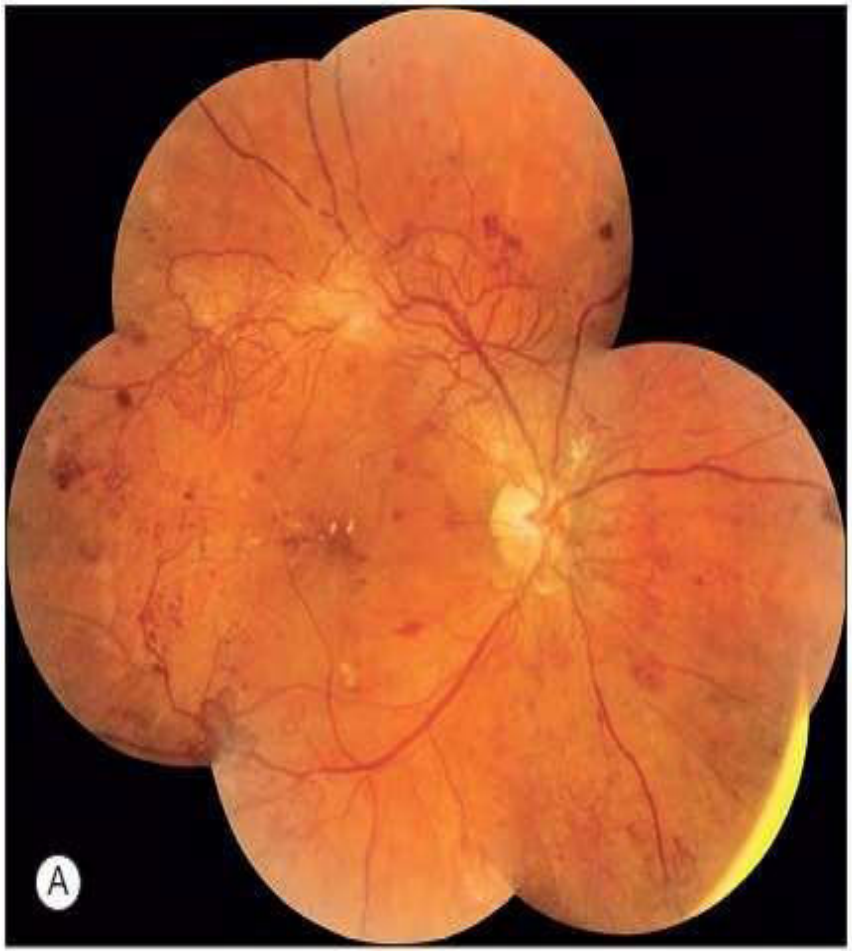
PED

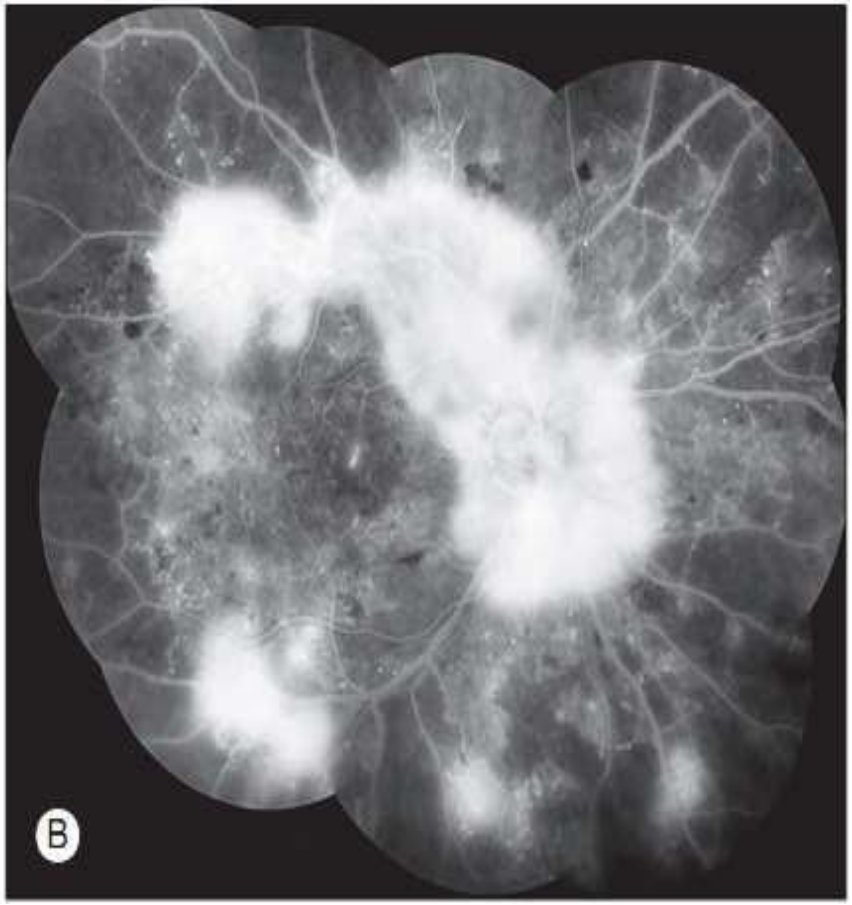


Leakage

- Leakage of dye is characterized by fairly early hyperfluorescence, increasing with time in both area and intensity.
- It occurs as a result of breakdown of the inner blood–retinal barrier due to:
  - Dysfunction or loss of existing vascular endothelial tight junctions as in
    - background diabetic retinopathy (DR),
    - retinal vein occlusion (RVO),
    - cystoid macular oedema and
    - papilloedema.
  - Primary absence of vascular endothelial tight junctions as in
    - CNV,
    - proliferative diabetic retinopathy ,
    - tumours and
    - some vascular anomalies such as Coats disease.

Neovascularization

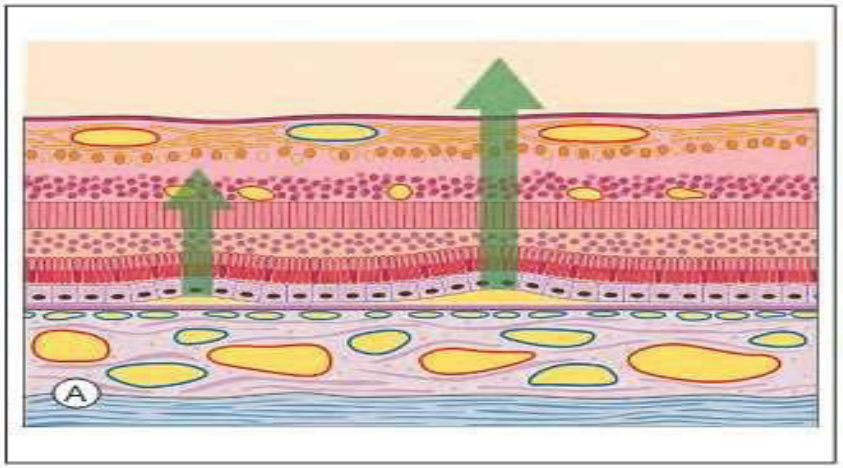


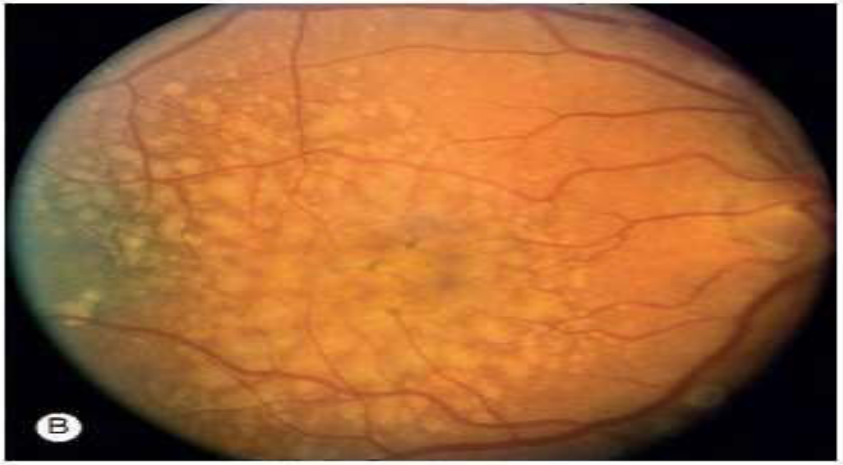


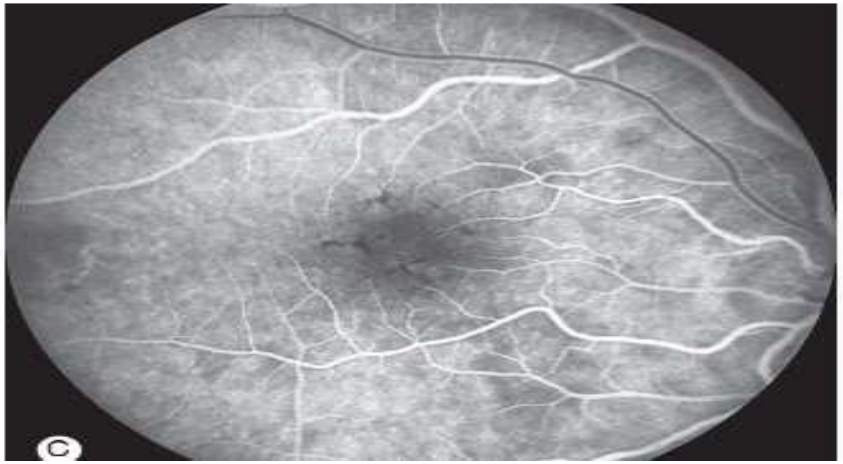
STAINING

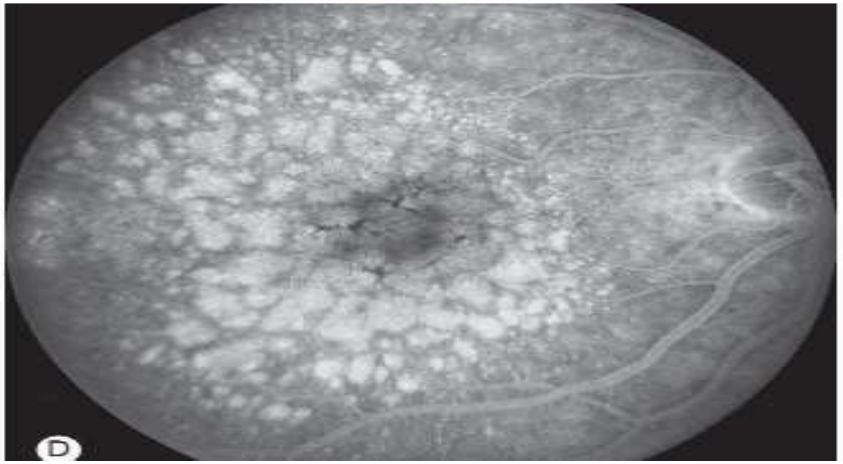
- It is a late phenomenon consisting of the prolonged retention of dye in entities such as
  - drusen
  - fibrous tissue
  - exposed sclera and
  - the normal optic disc
- it is seen in the later phases of the angiogram, particularly after the dye has left the choroidal and retinal circulations.

STAINING





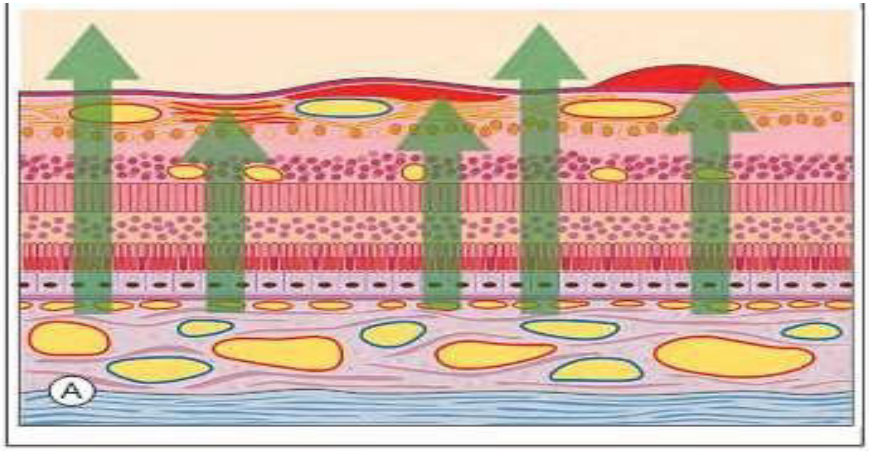


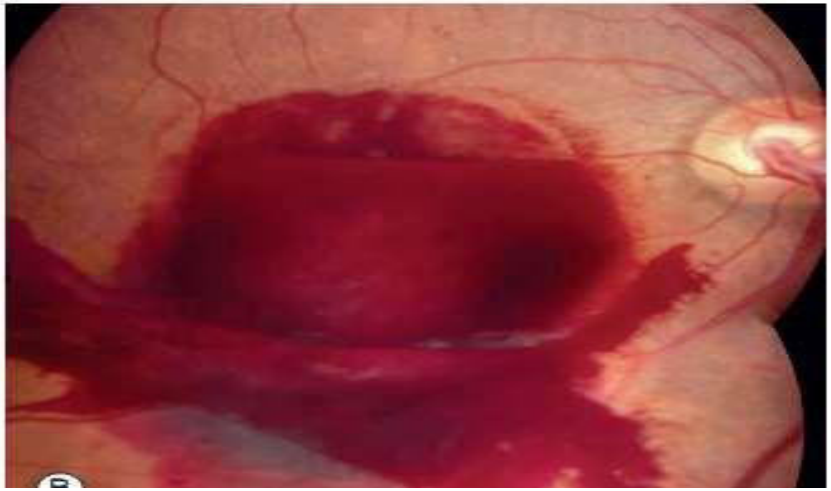


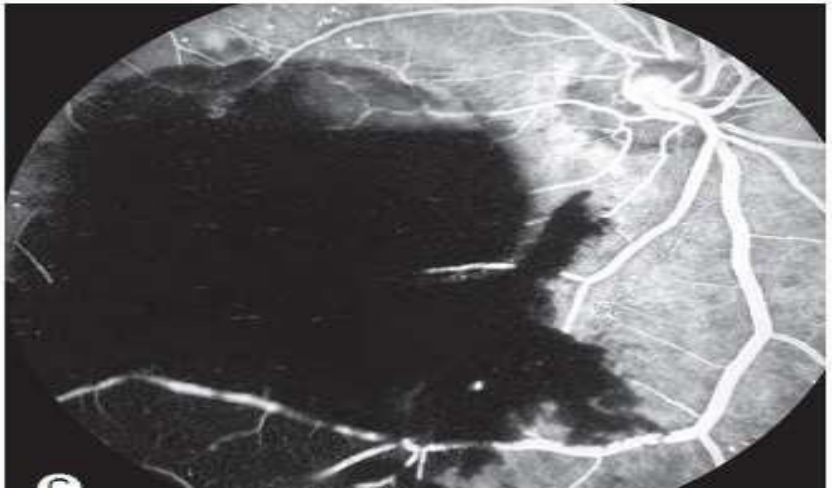
CAUSES OF HYPOFLUORESENCE

- BLOCKAGE
- VASCULAR FILLING DEFECT

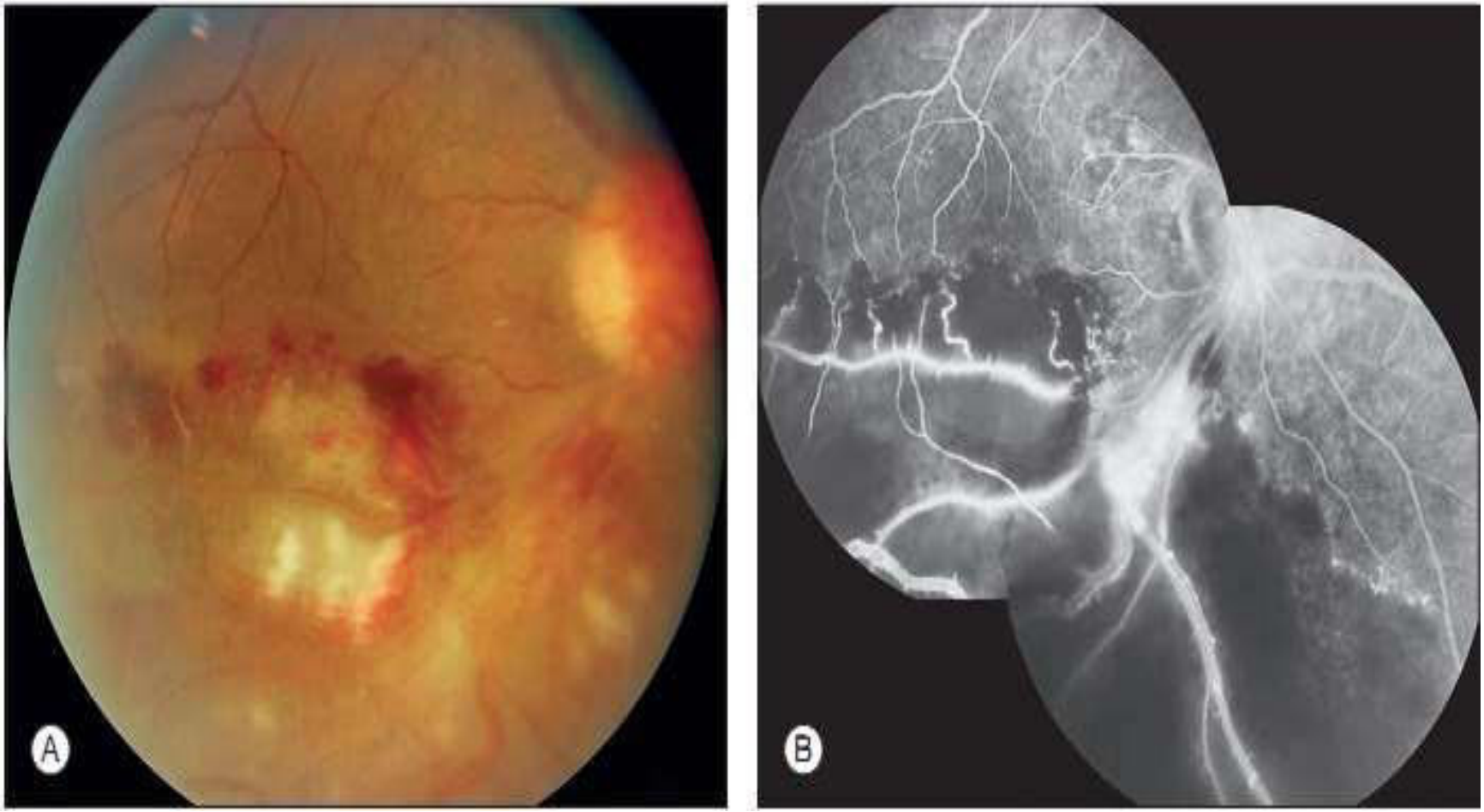
BLOCKAGE







VASCULAR FILLING DEFECT (BRVO)



USES OF FFA

- Evaluation of vascular integrity of retinal & choroidal vessels
- Disease process affecting macula
- Integrity of the Blood Ocular Barrier.
  - outer blood retinal barrier breaks in :- CSR
  - inner blood retinal barrier breaks in:- NVD ,NVE

- Determining the extent of damage
- Formulating the treatment strategy for retinal & choroidal disease.
- Monitoring the result of treatment.

COMPLICATIONS

MILD	MODERATE	SEVERE
Staining of skin, sclera and mucous membrane	Nausea ,vomiting	laryngeal edema bronchospasm
Stained secretion Tear, saliva	Vasovagal response	Circulatory shock, MI, cardiac arrest
Orange-yellow urine	urticaria	Generalized convulsion
Skin flushing, tingling lips, pruritus	fainting	Skin necrosis
	periphlebitis	

Table 8-2

List of Must-Have Pharmacologic Agents in an FA Facility

Adrenaline/epinephrine (1/10000) 1 mg/10ml *Preferably preloaded syringes (AnaKit/EpiPen)*
Atropine (1 mg/10 ml) (Atropair, Atropisol)
Atenolol (5 mg/10 ml) 0,4% IV **Lidocaine**
Diazepam (oral 5 to 10 mg, and 10mg/2ml ampoules)
Verapamil (5 mg/2 ml) or 50 mg/10ml IV **Urapidil** (Elgadil, in Europe)
Hydrocortisone hemisuccinate (100 mg/ml) or IV **Methylprednisolone** (20, 40, and 125 mg)
Methylxanthines (eg, **Aminophylline** 200mg/10 ml ampoules) **Salbutamol** (500 microg/1 ml ampoules and spray)
5mg/1ml IV **Dexchlorpheniramine** (Polaramine)
Nitroglycerin (1 mg sublingual, spray, and transdermal discs)
Promethazine hydrochloride (Phenergan) or 10 mg/2 ml **Metoclopramide** (IV and oral solution) in Europe.
Oral **glucose** (eg, oral gel, Glutose 15) Glucagon (Glucagen in Europe, acts faster than oral glucose in case of severe hypoglycemia if sufficient glucose in liver exists)
IV **Sodium bicarbonate** (1/6 M)
IV **Normal saline, Glucose saline** and **Ringer Lactate** (50, 100, and 500 ml, preferably in plastic bottles) 500 mL **Haemocel**

Table 6-3

Typical Contents of a Standard First Aid Kit in an FA Facility

- Examination gloves (small, medium, and large): sterile and nonsterile
- Stainless steel basins
- Emesis bags
- Cold/hot packs (in the refrigerator)
- 4 x 4 gauze packs
- Small bandages
- Scissors
- Gauze pads
- Adhesive tapes
- Skin cleanser (Alcohol, Betadine)
- Syringes (insulin, 2, 5, and 10 ml) and needles (different sizes)
- Tourniquets (Smark)

- Stethoscope
- Sphygmomanometer with several size cups
- Thermometer (fast reading, digital)
- Glucometer (eg, Accu-Trend)
- Automated external defibrillator

- Ambu bag
- Nasal cannulas
- Mayo cannulas (different sizes)
- Emergency tracheostomy cannula (kit)
- Pocket face mask (with one way valvula)
- O_2 portable cylinder with a low flow regulator

Contraindications of FFA

ABSOLUTE

1) known allergy
2) H/O adverse reaction in past

RELATIVE

- Asthma
- Hay fever
- Renal failure
- Hepatic failure
- Pregnancy (especially 1st trimester