

**FIGURE 40e-4** Deep and superficial retinal hemorrhages in a patient with chronic leukemia.

Conditions associated with retinal hemorrhages include diseases causing retinal microvasculopathy (Table 40e-3), retinitis, retinal macroaneurysm, papilledema, subarachnoid hemorrhage (Terson's syndrome), Valsalva retinopathy, trauma (ocular injury, head injury, compression injuries of chest and abdomen, shaken baby syndrome, strangulation), macular degeneration, and posterior vitreous detachment. Hyperviscosity states may produce dot and blot hemorrhages, dilated veins ("string of sausages" appearance), optic disc edema, and exudates; similar changes can occur with adaptation to high altitude in mountain climbers.

#### MICROANEURYSMS

Microaneurysms are outpouchings of the retinal capillaries, appearing as red dots (similar to dot hemorrhages) and measuring 15–50  $\mu\text{m}$ . Microaneurysms have increased permeability and may bleed or leak, resulting in localized retinal hemorrhage or edema. A microaneurysm ultimately thromboses and disappears within 3–6 months. Microaneurysms may occur in any condition that causes retinal microvasculopathy (Table 40e-3).

**TABLE 40e-3** DISEASES ASSOCIATED WITH RETINAL MICROVASCULOPATHY

- Diabetes mellitus
- Systemic hypertension
- Retinal vein occlusion
- Retinal artery occlusion
- Multiple microemboli, e.g., talc retinopathy secondary to intravenous drug abuse, septicemia, endocarditis, Purtscher's retinopathy
- Carotid artery disease, carotid-cavernous fistula, aortic arch syndrome
- Sickle cell retinopathy
- Radiation retinopathy, head/neck irradiation
- HIV retinopathy
- Retinal vasculitis
- Anemia
- Thrombocytopenia
- Lymphoproliferative disorders
- Coagulopathy
- Hyperviscosity syndromes
- Retinopathy of prematurity

#### HARD EXUDATES

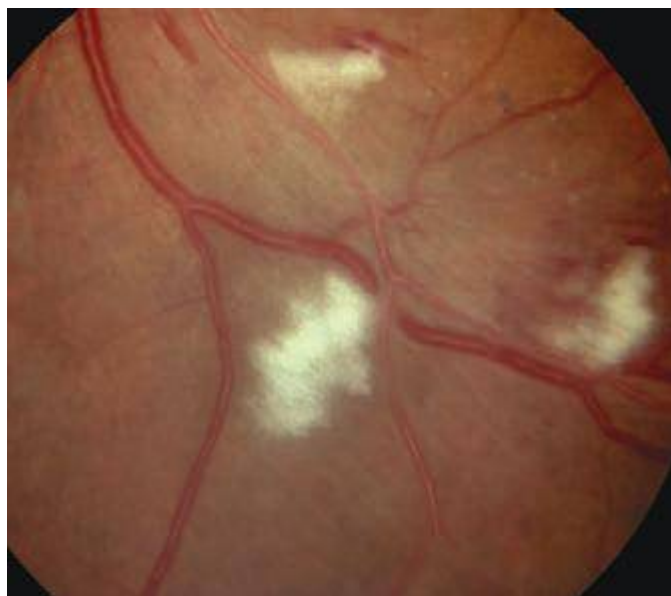
Hard exudates are well-circumscribed, shiny, yellow deposits located within the retina. They arise at the margins of areas of retinal edema and indicate increased capillary permeability. Hard exudates contain lipoproteins and lipid-laden macrophages. They may clear spontaneously or following laser photocoagulation, often within 6 months. Hard exudates may occur in isolation or may be scattered throughout the fundus. They may occur in a circular (circinate) pattern centered around an area of leaking microaneurysms. A macular star consists of a radiating, star-shaped pattern of hard exudates that is characteristically seen in severe systemic hypertension and in neuroretinitis associated with cat-scratch disease. Conditions associated with hard exudates include those causing retinal microvasculopathy (Table 40e-3), papilledema, neuroretinitis such as cat-scratch disease and Lyme disease, retinal vascular lesions (macroaneurysm, retinal capillary hemangioma, Coats' disease), intraocular tumors, and wet age-related macular degeneration. Drusen may be mistaken for hard exudates on ophthalmoscopy. Unlike hard exudates, drusen are nonrefractile subretinal deposits with blurred margins. They are usually seen in association with age-related macular degeneration.

#### COTTON-WOOL SPOTS

Cotton-wool spots are yellow/white superficial retinal lesions with indistinct feathery borders measuring 0.25–1 DD in size (Fig. 40e-5). They represent areas of edema within the retinal nerve fiber layer due to focal ischemia. Cotton-wool spots usually resolve spontaneously within 3 months. If the underlying ischemic condition persists, new lesions can develop in different locations. Cotton-wool spots often occur in conjunction with retinal hemorrhages and microaneurysms and represent retinal microvasculopathy caused by a number of systemic conditions (Table 40e-3). They may occur in isolation in HIV retinopathy, systemic lupus erythematosus, anemia, bodily trauma, other systemic conditions (Purtscher's/Purtscher's-like retinopathy), and interferon therapy.

#### RETINAL NEOVASCULARIZATION

Retinal neovascular complexes are irregular meshworks of fine blood vessels that grow in response to severe retinal ischemia or chronic inflammation (Fig. 40e-6). They may occur on or adjacent to the optic disc or elsewhere in the retina. Neovascular complexes are very



**FIGURE 40e-5** Cotton-wool spots, yellow-white superficial lesions with characteristic feathery borders, in a patient with hypertensive retinopathy. (From H Tabandeh, MF Goldberg: *Retina in Systemic Disease: A Color Manual of Ophthalmoscopy*. New York, Thieme, 2009.)