

Figure 8-51 *Strongyloides* hyperinfection in a patient treated with high-dose cortisone. A female, her eggs, and rhabditoid larvae are in the duodenal crypts; filariform larvae are entering the blood vessels and muscularis mucosa. (Courtesy Dr. Franz C. Von Lichtenberg, Brigham and Women's Hospital, Boston, Mass.)

maturity, and an intermediate host, in which the worm does not reach sexual maturity.

Taenia solium tapeworms consist of a head (scolex) that has suckers and hooklets that attach to the intestinal wall, a neck, and many flat segments called *proglottids* that contain both male and female reproductive organs. New proglottids develop behind the scolex. The most distal proglottids are mature and contain many eggs, and they can detach and be shed in the feces. *T. solium* can be transmitted to humans in two ways, ingestion of larval cysts or eggs, with distinct outcomes.

- Larval cysts, called cysticerci, are ingested in undercooked pork and attach to the intestinal wall, where they develop into mature adult tapeworms. These can grow to many meters in length and produce mild abdominal symptoms. The parasite life cycle is completed with this mode of infection and cysticercosis does not develop.
- When intermediate hosts (pigs or humans) ingest eggs in food or water contaminated with human feces, the larvae hatch, penetrate the gut wall, disseminate hematogenously, and encyst in many organs, giving rise to clinical symptoms of cysticercosis. The most serious manifestations result from encystment in the brain (neurocysticercosis). Convulsions, increased intracranial pressure, and other neurologic disturbances may occur. Adult tapeworms are not produced with this mode of infection since larval cysts lodged in various tissues cannot develop into mature worms. Viable *T. solium* cysts often do not produce symptoms and can evade host immune defenses by producing taeniaestatin and paramyosin, which seem to inhibit complement activation. When the cysticerci die and degenerate, an inflammatory response develops.

Taenia saginata, the beef tapeworm, and *Diphyllobothrium latum*, the fish tapeworm, are acquired by eating undercooked meat or fish. In humans these parasites live only in the gut, and do not form cysticerci.

Hydatid disease is caused by ingestion of eggs of echinococcal species. For *Echinococcus granulosus* the definitive host is the dog and the usual intermediate hosts

are sheep. For *Echinococcus multilocularis* the fox is the most important definitive host, and rodents are intermediate hosts. Humans are accidental intermediate hosts, infected by ingestion of food contaminated with eggs shed by dogs or foxes. Eggs hatch in the duodenum and invade the liver, lungs, or bones.

MORPHOLOGY

Cysticerci may be found in any organ, but the more common locations include the brain, muscles, skin, and heart. Cerebral symptoms depend on the precise location of the cysts, which may be intraparenchymal, attached to the arachnoid, or freely floating in the ventricular system. The cysts are ovoid and white to opalescent, often grape-sized, and contain an invaginated scolex with hooklets that are bathed in clear cyst fluid (Fig. 8-52). The cyst wall is more than 100 μm thick, is rich in glycoproteins, and evokes little host inflammatory response when it is intact. When cysts degenerate, however, there is inflammation, followed by focal scarring, and calcifications, which may be visible by radiography.

About two thirds of human *E. granulosus* cysts are found in the liver, 5% to 15% in the lung, and the rest in bones and brain or other organs. In the various organs the larvae lodge within the capillaries and first incite an inflammatory reaction composed principally of mononuclear leukocytes and eosinophils. Many such larvae are destroyed, but others encyst. The cysts begin at microscopic levels and progressively increase in size, so that in 5 years or more they may have achieved dimensions of more than 10 cm in diameter. Enclosing an opalescent fluid is an inner, nucleated, germinative layer and an outer, opaque, non-nucleated layer. The outer non-nucleated layer is distinctive and has innumerable delicate laminations. Outside this opaque layer, there is a host inflammatory reaction that produces a zone of fibroblasts, giant cells, and mononuclear and eosinophilic cells. In time a dense fibrous capsule forms. Daughter cysts often develop within the large mother cyst. These appear first as minute projections of the germinative layer that develop central vesicles and thus form tiny brood capsules. Degenerating scolices of the worm produce a fine, sandlike sediment within the hydatid fluid (hydatid sand).

Trichinosis

Trichinella is a species of nematode parasite that is acquired by ingestion of larvae in undercooked meat from infected

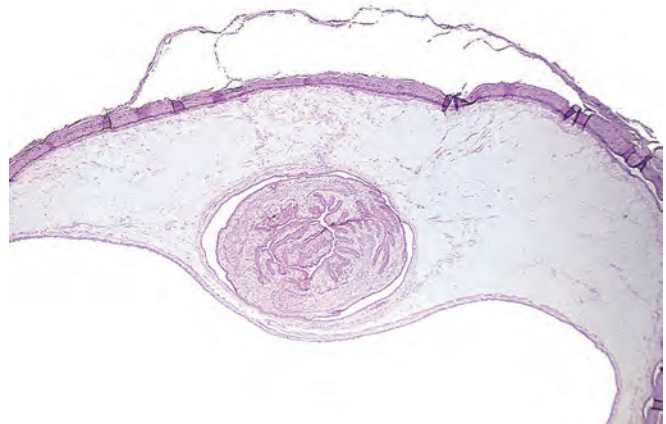


Figure 8-52 Portion of a cysticercus cyst in the skin.