

Figure 9-20 Chronic radiation dermatitis with atrophy of epidermis, dermal fibrosis, and telangiectasia of the subcutaneous blood vessels. (American Registry of Pathology © 1990.)

a recent large-scale epidemiologic study showing that children who receive at least two CT scans have very small but measurable increased risks for leukemia and malignant brain tumors, and on older studies showing that radiation therapy to the chest is particularly likely to produce breast cancers when administered to adolescent females.

Increased risk of cancer development may also be associated with occupational exposures. *Radon* gas is a ubiquitous product of the spontaneous decay of uranium. Its carcinogenic effects are largely attributable to two decay products, *polonium 214* and *polonium 218* (or “radon daughters”), which emit alpha particles. Polonium 214 and 218 produced from inhaled radon tend to deposit in the lung, and chronic exposure in uranium miners may give rise to lung carcinomas. Risks are also present in homes in which the levels of radon are very high, comparable to those found in mines. However, there is little evidence to suggest that radon contributes to the risk of lung cancer in the average household. For historical reasons, we also mention here the development of osteogenic sarcomas after radium exposure in radium dial painters, chemists, radiologists, and patients exposed to radium as a treatment for various ailments during the first part of the twentieth century.

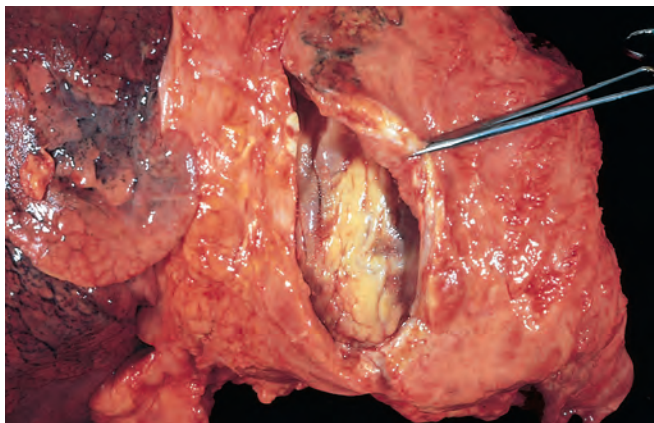


Figure 9-21 Extensive mediastinal fibrosis after radiotherapy for carcinoma of the lung. Note the markedly thickened pericardium. (From the teaching collection of the Department Pathology, Southwestern Medical School, Dallas, TX.)

KEY CONCEPTS

Radiation Injury

- Ionizing radiation may injure cells directly or indirectly by generating free radicals from water or molecular oxygen
- Ionizing radiation damages DNA; therefore, rapidly dividing cells such as germ cells, and those in the bone marrow and gastrointestinal tract are very sensitive to radiation injury
- DNA damage that is not adequately repaired may result in mutations that predispose affected cells to neoplastic transformation
- Ionizing radiation may cause vascular damage and sclerosis, resulting in ischemic necrosis of parenchymal cells and their replacement by fibrous tissue

Nutritional Diseases

Malnutrition, also referred to as *protein energy malnutrition* or *PEM*, is a consequence of inadequate intake of proteins and calories, or deficiencies in the digestion or absorption of proteins, resulting in the loss of fat and muscle tissue, weight loss, lethargy, and generalized weakness. Millions of people in developing nations are malnourished and starving, or living on the cruel edge of starvation. In the industrial world and, more recently, also in developing countries, *obesity* has become a major public health problem due to its association with the development of diseases such as diabetes, atherosclerosis, and cancer.

The sections that follow barely skim the surface of nutritional disorders. Particular attention is devoted to PEM, anorexia nervosa and bulimia, deficiencies of vitamins and trace minerals, obesity, and a brief overview of the relationships of diet to atherosclerosis and cancer. Other nutrients and nutritional issues are discussed in the context of specific diseases.

Dietary Insufficiency

An appropriate diet should provide (1) sufficient energy, in the form of carbohydrates, fats, and proteins, for the body’s daily metabolic needs; (2) amino acids and fatty acids to be used as building blocks for synthesis of proteins and lipids; and (3) vitamins and minerals, which function as coenzymes or hormones in vital metabolic pathways or, as in the case of calcium and phosphate, as important structural components. In *primary malnutrition*, one or all of these components are missing from the diet. By contrast, in *secondary malnutrition*, malnutrition results from malabsorption, impaired utilization or storage, excess loss, or increased need for nutrients.

There are several conditions that may lead to primary or secondary malnutrition.

- *Poverty*. Homeless persons, aged individuals, and children of the poor often suffer from PEM as well as trace nutrient deficiencies. In poor countries, poverty, crop failures, livestock deaths, and drought, often in times of war and political upheaval, create the setting for the malnourishment of children and adults.