



Figure 9-6 Pathologic features of lead poisoning in adults.

≤15% in adults); the higher intestinal absorption and the more permeable blood-brain barrier of children create a high susceptibility to brain damage. The neurotoxic effects of lead are attributed to the inhibition of neurotransmitters caused by the disruption of calcium homeostasis. Other effects of lead exposure include the following:

- Lead interferes with the normal remodeling of cartilage and primary bone trabeculae in the epiphyses in children. This causes increased bone density detected as radiodense “lead lines” (Fig. 9-7; another type of lead line appears in the gums as a result of hyperpigmentation).
- Lead inhibits the healing of fractures by increasing chondrogenesis and delaying cartilage mineralization.
- Lead inhibits the activity of two enzymes involved in heme synthesis, δ -aminolevulinic acid dehydratase and

ferrochelatase. Ferrochelatase catalyzes the incorporation of iron into protoporphyrin, and its inhibition causes a rise in protoporphyrin levels. The resulting heme deficiency causes various abnormalities, but the most obvious is a *microcytic hypochromic anemia* stemming from the suppression of hemoglobin synthesis.

The diagnosis of lead poisoning requires constant awareness of its prevalence. In children it may be suspected on the basis of neurologic and behavioral changes, or by unexplained microcytic anemia. Definitive diagnosis requires the detection of elevated blood levels of lead and free (or zinc-bound) red cell protoporphyrin.

MORPHOLOGY

The major anatomic targets of lead toxicity are the bone marrow and blood, nervous system, gastrointestinal tract, and kidneys (Fig. 9-6).

Blood and marrow changes occur fairly rapidly and are characteristic. The inhibition of ferrochelatase by lead may result in the appearance of a few **ring sideroblasts**, red cell precursors with iron-laden mitochondria that are detected with a Prussian blue stain. In the peripheral blood the defect in hemoglobin synthesis appears as a **microcytic, hypochromic anemia** that is often accompanied by mild **hemolysis**. Even more distinctive is a **punctate basophilic stippling of the red cells**.

Brain damage is prone to occur in children. It can be very subtle, producing mild dysfunction, or it can be massive and lethal. In young children, sensory, motor, intellectual, and psychologic impairments have been described, including reduced IQ, learning disabilities, retarded psychomotor development, blindness, and, in more severe cases, psychoses,



Figure 9-7 Lead poisoning. Impaired remodeling of calcified cartilage in the epiphyses (arrows) of the wrist has caused a marked increase in their radiodensity, so that they are as radiopaque as the cortical bone. (Courtesy Dr. G. W. Dietz, Department of Radiology, University of Texas Southwestern Medical School, Dallas, Texas.)