Fig. 12.1. Sources and routes of removal of common serum enzymes. Major sources of serum enzymes that contribute to increased serum activities are hepatocytes (ALT, AST, GGT, GMD, ID, LD, and ALP), biliary epithelial cells (ALP and GGT), skeletal and cardiac muscle fibers (CK, AST, LD, and ALT), osteoblasts (ALP), and pancreatic acinar cells (AMS and LPS). In vitro release of AST and LD from erythrocytes can increase serum activities. Kidneys either inactivate or excrete AMS and LPS. The biliary system is a route of excretion of hepatic ALP and GGT. GGT released from damaged renal tubular cells is excreted in urine. Macrophages probably are involved in removal of damaged or degraded enzymes and enzyme-antiprotease complexes.

Fig. 12.2. Release of cytosolic enzymes by blebbing or necrosis. Blebbing and necrosis may increase serum activity of ALT, AST, LD, ID, GMD, CK, AMS, LPS, and, to a mild degree, ALP and GGT. A variety of insults to cells may cause direct necrosis or membrane blebbing (irreversible or reversible damage). If irreversible cell damage occurs, cellular enzymes are released with or without bleb formation. If reversible damage occurs, blebosomes form and later lyse, thus releasing their enzymes. E, enzyme.

Fig. 12.3. Increased production of ALP by induction. In healthy animals (the *left* half of the drawing), ALP is attached to hepatocyte membranes; more is located on the canalicular than the sinusoidal membrane. In sick animals (the *right* half of the drawing), drugs or metabolites (e.g., bile acid) induce the synthesis of more ALP that accumulates both on the canalicular and sinusoidal hepatocyte membranes. When more ALP is released from the sinusoidal membrane, serum ALP activity increases. aa, amino acid.

Fig. 12.4. Initial reactions in assays for the common clinical serum enzymes. Assays are designed so that the rate-limiting factor is the catalytic activity of a serum enzyme. Methods of monitoring the chemical reactions that are catalyzed by the enzymes vary but typically involve absorption or reflectance photometry. LD activity can be assessed in reactions that are driven from lactate to pyruvate or pyruvate to lactate. mRNA, messenger ribonucleic acid; and NH_4^+, ammonium.

Fig. 12.5. Interpretation of a single enzyme activity. On the day of sampling, all three patients' enzyme activities (●) were about 3 × URL (*shaded* area). For animal A (- - -), the 3 × value occurred during the disappearance phase after an acute increase. For animal B (– – –), the 3 × value reflects a persistent pathologic process. For animal C (— — —), the 3 × value occurred during a progressive pathologic process. Thus, the clinical significance of the single measurement of enzyme activity may vary from animal to animal.