sufficiently large amount of deconjugated bilirubin left to allow pigment stones to form.

MORPHOLOGY

Cholesterol stones arise exclusively in the gallbladder and range from 100% pure (which is rare) down to around 50% cholesterol. Pure cholesterol stones are pale yellow, round to ovoid, and have a finely granular, hard external surface (Fig. 18-62), which on transection reveals a glistening radiating crystalline palisade. With increasing proportions of calcium carbonate, phosphates, and bilirubin, the stones take on a gray-white to black color and may be lamellated. Multiple stones are usually present that range up to several centimeters in diameter. Rarely, a very large stone may virtually fill the fundus. Surfaces of multiple stones may be rounded or faceted, because of tight apposition. Stones composed largely of cholesterol are radiolucent; sufficient calcium carbonate is found in 10% to 20% of cholesterol stones to render them radiopaque.

Pigment gallstones are brown to black. In general, black pigment stones are found in sterile gallbladder bile and brown stones are found in infected large bile ducts. Black stones contain oxidized polymers of the calcium salts of unconjugated bilirubin, small amounts of calcium carbonate, calcium phosphate, and mucin glycoprotein, and some cholesterol monohydrate crystals. Brown stones contain similar compounds along with some cholesterol and calcium salts of palmitate and stearate. The black stones are rarely greater than 1.5 cm in diameter, are almost invariably present in great number (with an inverse relationship between size and number; Fig. 18-63), and are quite friable. Their contours are usually spiculated and molded. Brown stones tend to be laminated and soft and may have a soaplike or greasy consistency. Approximately 50% to 75% of black stones are radiopaque due to calcium salts while brown stones, containing calcium soaps, are radiolucent. Mucin glycoproteins constitute the scaffolding and interparticle cement of all types of stones.

Clinical Features. Gallstones may be present for decades before symptoms develop, and 70% to 80% of patients remain asymptomatic throughout their lives. Asymptomatic individuals probably convert to being symptomatic at a rate of up to 4% per year, although the risk diminishes with time. Prominent among symptoms is *biliary colic* that may be excruciating. Despite its characterization as "colic" it is usually constant and not colicky. It usually follows a fatty meal which forces a stone against the gall bladder outlet leading to increased pressure in the gall bladder causing pain. Pain is localized to right upper quadrant or epigastrium that may radiate to the right shoulder or the back. Inflammation of the gallbladder (cholecystitis, discussed later), in association with stones, also generates pain. More severe complications include *empyema, perforation, fistulas, inflammation of the biliary tree (cholangitis), obstructive cholestasis* and *pancreatitis.* The larger the calculi, the less likely they are to enter the cystic or common ducts to produce obstruction; it is the very small stones, or "gravel," that are more dangerous. Occasionally a large stone may erode directly into an adjacent loop of small bowel, generating intestinal obstruction ("*gallstone ileus*" or *Bouveret syndrome*). Lastly (but not least), gallstones are associated with an increased risk of gallbladder carcinoma, discussed later.

Figure 18-62 Cholesterol gallstones. The wall of the gallbladder is thickened and fibrotic due to chronic cholecystitis.

Figure 18-63 Pigment gallstones. Several faceted black gallstones are present in this otherwise unremarkable gallbladder from a patient with a mechanical mitral valve prosthesis, leading to chronic intravascular hemolysis.

Cholecystitis

Inflammation of the gallbladder may be acute, chronic, or acute superimposed on chronic. It almost always occurs in association with gallstones. In the United States cholecystitis is one of the most common indications for abdominal surgery. Its epidemiologic distribution closely parallels that of gallstones.

Acute Cholecystitis

Acute calculous cholecystitis is precipitated in 90% of cases by obstruction of the neck or the cystic duct by a stone. It is the primary complication of gallstones and the most common reason for emergency cholecystectomy. *Cholecystitis without gallstones (acalculous cholecystitis) may occur in severely ill patients and accounts for about 10% of patients with cholecystitis.*