Segmental Surgical Disease of the Liver

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THE SIMILARITY of the circulation and ductile system of the liver and lung has been known for many years.[5, 6] Practical application of this knowledge has been hindered by the rare instances of disease of the liver encountered and by the difficulty in securing hemostasis in this vascular organ. To date, this application has been limited to right or left hepatic lobectomy;[2, 8, 9] extended right hepatectomy including the medial segment of the left lobe;[9] the recognition of a syndrome of unilateral hepatic duct obstruction;[1] excision of the lateral segment of the left lobe for tumors or in the course of the Longmire procedure;[7] and resection of the medial segment of the left lobe for metastatic carcinoma.[10] In this report, I would like to draw attention to cases of calculus, neoplastic and benign stricture, and septic disease involving various segments of the liver which illustrate the spectrum of surgical segmental disease of the liver and its treatment. At this time, these diseases are either unknown or rarely reported in the surgical literature.

Lobar and Segmental Anatomy of the Liver

On the basis of the courses of the right and left hepatic arteries, portal veins, and hepatic ducts, the liver can be divided into right and left lobes by a plane passing posteriorly from the gallbladder bed to the vena cava.[3, 11] The simplest classification of the subdivisions of each lobe has been suggested by Healey and Schroy,[4] and their nomenclature will be used in this report. Thus the right lobe is divided into anterior (ventrocranial) and posterior (dorsocaudal) segments, and the left lobe is composed of medial and lateral segments. Figure 1A depicts a right lateral view of the segments of the right lobe and Figure 1B shows the anterior view of the segments of the right and left lobes. Figure 2 illustrates the various segmental ducts as outlined on a T tube cholangiogram. The quadrate and caudate "lobes" are not true anatomical lobes and share their ductile and afferent vascular supply from both left and right vessels and ducts. The hepatic veins course in the intersegmental and interlobar planes as do the pulmonary veins.

Case Reports

Calculus

Case 1. This woman was first seen at the Lahey Clinic Foundation in 1958 at the age of 56. Seven years before admission, she had had a cholecystectomy and choledochostomy for stones with subsequent recurrent right upper quadrant pain with chills, nausea, and fever. Two years previously she had a choledochostomy and transduodenal sphincterotomy for recurrent stones in the common bile duct which did not relieve symptoms present upon admission. On examination she was jaundiced.

At operation a cholangiogram (Fig. 3) demonstrated that the anterior segmental duct of the right lobe was inserted low into the cystic duct and that this duct was packed with stones. They

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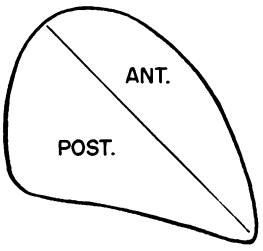

FIG. 1A. Right lateral view of anterior and posterior segments of the right lobe of the liver.

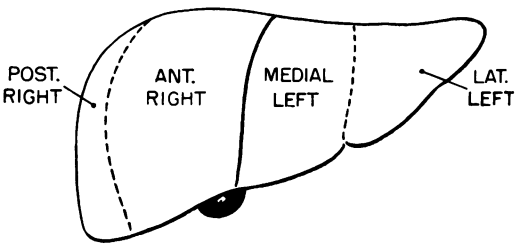

FIG. 1B. Anterior view of anterior and posterior segments of the right lobe and medial and lateral segments of the left lobe of the liver.

were removed and the patient has been well for 9 years.

Comment. In this case the unusual variation of insertion of the anterior segmental duct into the cystic duct was not recognized until an operative cholangiogram demonstrated this extrahepatic segmental duct to be packed with stones. At previous choledochostomies, probes had passed proximally into what had seemed to be right and left hepatic ducts which were freed of calculi.

Tumor

Case 2. This patient, a woman aged 55, had recurrent epigastric pain of 25 years' duration. The pain radiated across the upper part of the abdomen but not through to the back. It usually lasted for 1 day to 3 weeks. On physical examination, a mass was palpable in the epigastrium, and barium swallow x-rays (Fig. 4) showed displacement of the lesser curvature of the stomach to the left.

At laparotomy a large cyst containing 800 cc. of serous fluid was found to occupy the lateral segment of the left lobe of the liver. This segment of the liver was resected and one year later the patient was asymptomatic. In the opinion of the pathologist, the tumor (Fig. 5) was a bile duct cyst.

Case 3. A 57-year-old woman was referred with the diagnosis of tumor of the left hepatic duct. This diagnosis had been made elsewhere by operative choledochoscopy performed with an infant cystoscope. This previous laparotomy had been performed because of massive intermittent hematobilia. At operation (performed by Dr. Cornelius E. Sedgwick), a duct was found coursing posteriorly and to the right from its intrahepatic junction with the left hepatic duct. An operative cholangiogram (Fig. 6) showed this duct to be dilated and apparently to contain a filling defect. A modified left hepatectomy was performed following which the involved duct and tumor were excised from the remaining liver mass. The pathologists reported the tumor to be a low-grade papillary adenocarcinoma of an intrahepatic duct. The patient recovered uneventfully from this procedure.

At another laparotomy 5 months later, performed because of chills, fever, and epigastric discomfort, a small subhepatic abscess was drained. She is now well 9 months after resection.

Comment. This is an example of insertion of the right posterior segmental duct into the left hepatic duct (Fig. 7) with resulting difficulty in lateralizing the source of the hematobilia. No procedure has been described for segmental resection of either the anterior or posterior segments of the right lobe of the liver. The technic used in this case was a fortunate improvization since the mass in the left liver lobe was relatively small.

Benign Stricture

Case 4. This woman was first seen at the clinic in 1961 at the age of 46. In the succeeding 2½ years she had three repairs (by dilatation) of a biliary stricture which at first involved the right hepatic duct and later both the right and left ducts. At the last procedure a Y tube was inserted. She was again operated upon in 1964 because of persisting jaundice, itch, chills, and fever. At that time needling of the right lobe of the liver disclosed a dilated and obstructed posterior right hepatic duct (Fig. 8). This duct was anastomosed to a jejunal loop. In the succeeding 3 years the patient's condition has greatly improved.

Comment. This case is an example of jaundice associated with segmental duct obstruction in which the segmental duct

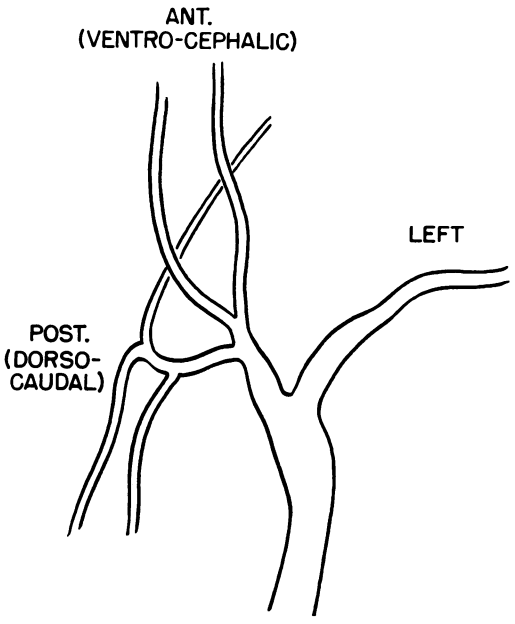

FIG. 2A. Segmental ducts identifiable on a normal cholangiogram.

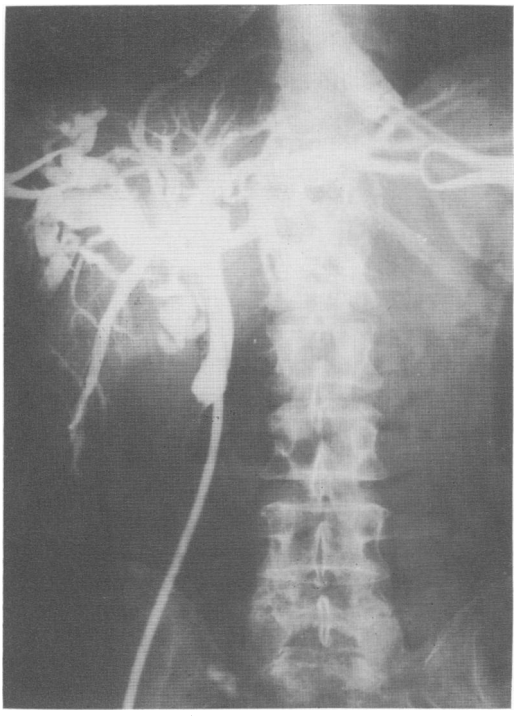

FIG. 3. Cholangiogram demonstrating anomalous anterior segmental duct of right lobe containing calculi and joining the cystic duct stump.

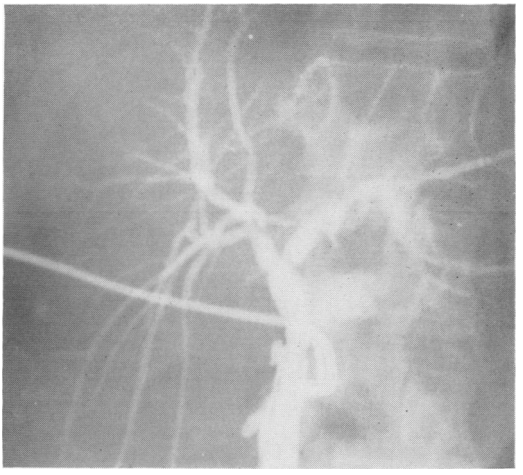

FIG. 2B. Normal T tube cholangiogram.

drained an appreciable proportion of the functioning liver tissue.

Sepsis

Case 5. A 70-year-old man consulted us in January 1967 because of daily, shaking chills with fever to at least 104° F. He had previously had two choledocholithotomies with a choledocho-jejunostomy, side-to-side, performed at the second procedure. Serum bilirubin was 4.0 mg./100 ml. and the alkaline phosphatase, 40 Bodansky units. The results of the flocculation tests were normal.

At operation the caudate lobe was enormous. The lateral part of the left lobe was fibrotic and fused with the undersurface of the diaphragm. An operative cholangiogram (Fig. 9) showed saccular dilatation of the lateral segmental branches of the left hepatic duct. The lateral segment of the left lobe, corresponding with the fibrotic part of the liver, was resected. The specimen (Fig. 10) showed chronic inflammation and saccular dilatation of the ducts. In February 1968, the patient returned with jaundice and low-grade fever of 1 month's duration. At laparotomy, an obvious malignant tumor involved the hilus of the liver. Biopsy disclosed a low-grade adenocarcinoma of probable ductile origin. It is now clear that the segmental sepsis was caused by obstruction to the left lateral segmental ducts by a carcinoma of the intrahepatic portion of the left hepatic duct. Its location is possibly visible in Figure 9 just proximal to the dilated distal ducts.

Discussion

Variations in the site of junction of the anterior and posterior divisions of the right

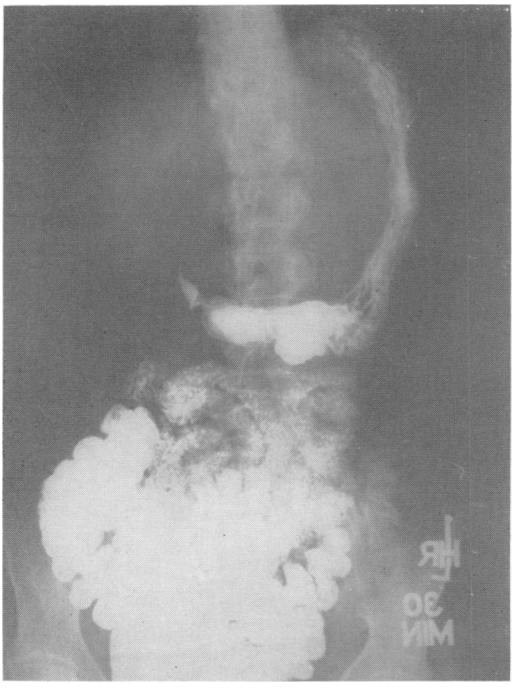

FIG. 4. Displacement of lesser curvature of stomach by cyst in left lateral segment of liver.

hepatic duct have been studied by Healey and Schroy and the more common arrangements are depicted in Figure 7. The practical importance of variations in this junc-

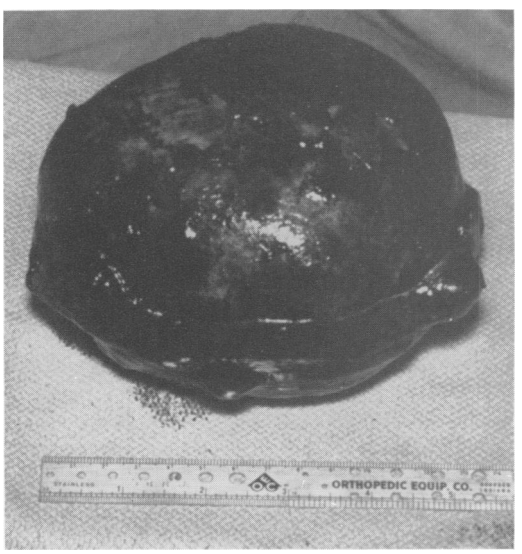

FIG. 5. Bile duct cyst of left lateral segment of liver.

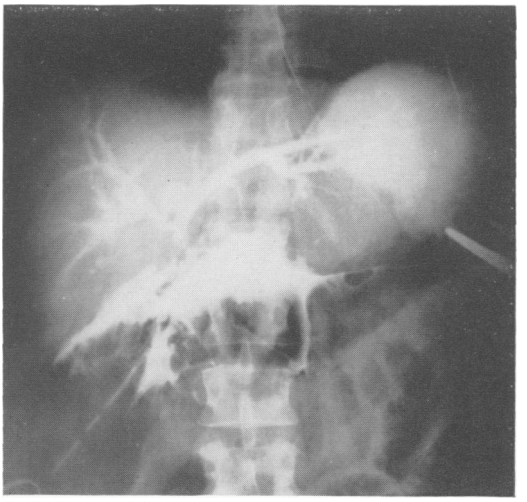

FIG. 6. Operative cholangiogram demonstrating dilated posterior segmental duct of right hepatic lobe containing a neoplasm.

tion is illustrated in Cases 1 and 3. In Case 1 the anterior right duct with its contained stones could not be identified on routine probing of the common bile duct because of its insertion into the cystic duct, an extremely rare situation. In Case 3 the intrahepatic juncture of the posterior right duct with the left hepatic duct caused confusion in lateralization of the source of hematobilia when blood was seen coming from the left hepatic duct. Finally, in the performance of cholecystectomy the surgeon should be aware of the possibility that segmental ducts from the right lobe may be situated in Calot's triangle and thus vulnerable to injury.

Preble and I[1] have previously commented on the jaundice associated with unilateral hepatic duct obstruction and have reported four cases of this syndrome. We have further developed this observation and have reported jaundice associated with a stricture of the right posterior segmental duct in Case 4. In contrast, Figure 11 is a cholangiogram outlining a left hepatic duct obstructed by a benign stricture. In this case, very little functioning liver tissue remained which was drained by this duct. This patient noted only chills and

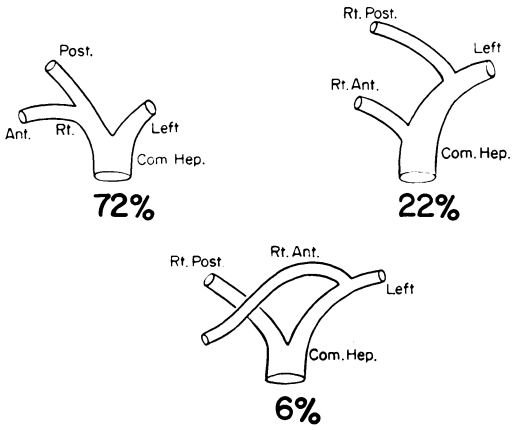

FIG. 7. Variations in site of juncture of anterior and posterior segmental ducts of the right lobe of the liver.

fever, without clinical or laboratory jaundice. Apparently the development of jaundice is dependent on a critical amount of functioning liver tissue drained by the obstructed duct.

It is evident from the foregoing that in the surgical treatment of bile duct calculi and benign stricture, all segments of the liver must be demonstrated free of obstruction. It is our practice to accomplish this by T tube or Foley catheter operative cholangiography before the anastomoses are started in cases of repair of stricture or before the operation is terminated in patients who have hepatic or common duct stones. Occasionally, lateral or oblique views of the ducts are desirable for positive identification of the hepatic segmental ducts. To date we have used these variations in technic only in postoperative examinations.

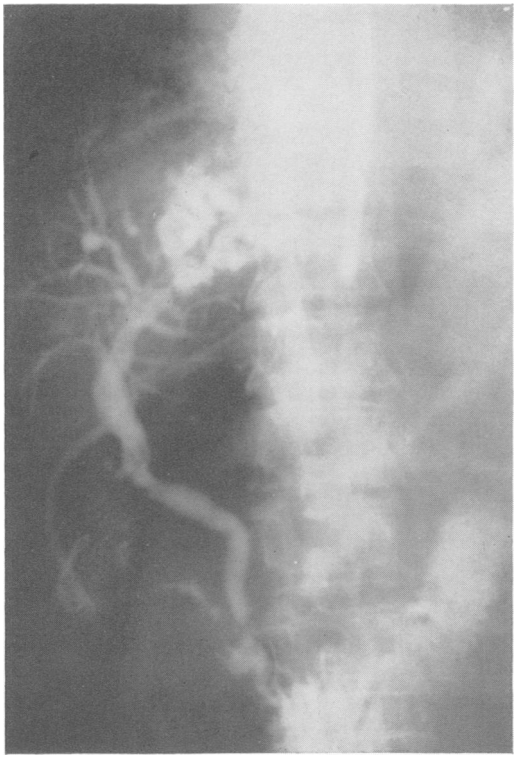

FIG. 9. Operative cholangiogram showing saccular dilatation of peripheral branches of the lateral left hepatic duct.

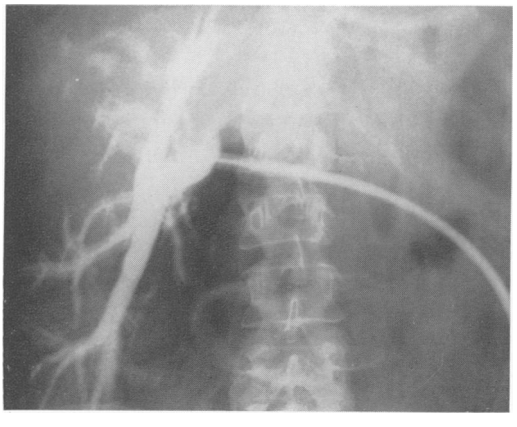

FIG. 8. Operative cholangiogram showing obstructed, dilated, posterior segmental duct of the right hepatic lobe.

FIG. 10. Resected specimen of left lateral segment of liver showing fibrosis, chronic inflammation, and saccular duct dilatation.

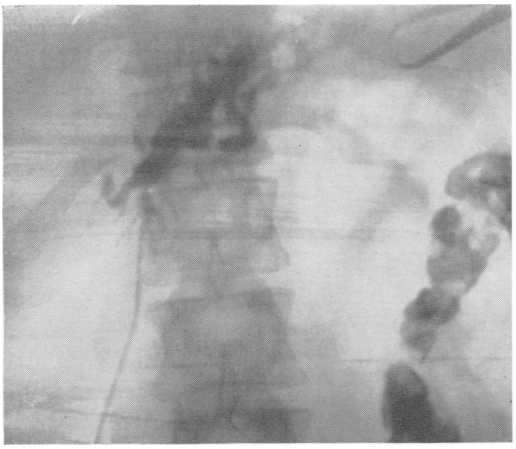

FIG. 11. Cholangiogram demonstrating obstructed and dilated left hepatic duct.

Case 5 is unique in that segmental sepsis of the liver has not been reported heretofore. The cause of this sepsis is unknown although some of the cholangiograms suggest an intrahepatic stricture of the distal portion of the left hepatic duct as a basis for this condition.

Summary

Cases are reported illustrating calculous disease of the right anterior segmental duct, benign stricture of the right posterior segmental duct, carcinoma of the right posterior segmental duct, cyst of the lateral segment of the left hepatic lobe, and sepsis of the lateral segment of the left hepatic lobe.

Knowledge of and cholangiographic demonstration of the segments of the liver and their ducts are essential in the diagnosis and surgical treatment of liver and biliary tract disease.

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