therapy. Radiologic evaluation typically starts with ultrasound, which is very useful in visualizing dilated bile ducts, and then proceeds with either MRI or magnetic resonance cholangiopancreatography (MRCP) or helical CT scans. Invasive cholangiopancreatography (ERCP) is then needed to define the biliary tree and obtain a biopsy or is needed therapeutically to decompress an obstructed biliary tree with internal stent placement. If that fails, then percutaneous biliary drainage will be needed, with the biliary drainage flowing into an external bag. Central tumors often invade the porta hepatis, and locoregional lymph node involvement by tumor is frequent. Incidence has been increasing in recent decades; few patients survive 5 years. The usual treatment is surgical, but combination systemic chemotherapy may be effective. After complete surgical resection for IHC, 5-year survival is 25–30%. Combination radiation therapy with liver transplant has produced a 5-year recurrence-free survival rate of 65%.

TREATMENT CHOLANGIOCARCINOMA

Hilar CCC is resectable in ~30% of patients and usually involves bile duct resection and lymphadenectomy for prognostication. Typical survival is approximately 24 months, with recurrences being mainly in the operative bed but with ~30% in the lungs and liver. Distal CCC, which involves the main ducts, is normally treated by resection of the extrahepatic bile ducts, often with pancreaticoduodenectomy. Survival is similar. Due to the high rates of locoregional recurrences or positive surgical margins, many patients receive postoperative adjuvant radiotherapy. Its effect on survival has not been assessed. Intraluminal brachyradiotherapy has also shown some promise. However, photodynamic therapy enhanced survival in one study. In this technique, sodium porfimer is injected intravenously and then subjected to intraluminal red light laser photoactivation. OLTX has been assessed for treatment of unresectable CCC. Five-year survival was ~20%, so enthusiasm waned. However, neoadjuvant radiotherapy with sensitizing chemotherapy has shown better survival rates for CCC treated by OLTX and is currently used by UNOS for perihilar CCC <3 cm with neither intrahepatic or extrahepatic metastases. A 12-center data collection study of 287 patients with perihilar CCC confirmed the benefit of this approach in a subset of patients, with a 53% 5-year survival rate but with 10% patient dropout before transplantation. The patients had neoadjuvant external radiation with radiosensitizing therapy. Patients with tumors >3 cm had significantly shorter survival. Multiple chemotherapeutic agents have been assessed for activity and survival in unresectable CCC. Most have been inactive. However, both systemic and hepatic arterial gemcitabine have shown promising results. The combination of cisplatin plus gemcitabine has produced a survival advantage compared with gemcitabine alone in a 410-patient randomized controlled phase III trial for patients with locally advanced or metastatic CCC and is now considered standard therapy for unresectable CCC. Median overall survival in the combination arm was 11.7 months versus 8.1 months for gemcitabine alone. Significant responses were seen mainly in patients with IHC and gallbladder cancer. However, neither surgery for lymph node–positive disease nor regional chemotherapy in nonsurgical patients has shown any survival advantage thus far. Several case series have shown safety and some responses for hepatic arterial chemotherapy with gemcitabine, drug-eluting beads, and ^{90}Yttrium microspheres, but no convincing clinical trials are available. Clinical trials are under way with targeted therapies. Bevacizumab plus erlotinib gave a 10% partial response rate with median overall survival of 9.9 months. A sorafenib trial yielded an overall survival of 4.4 months, but 50% of the patients had received previous chemotherapy. Patients with unresectable tumors should be treated in clinical trials.

GALLBLADDER CANCER

Gallbladder (GB) cancer has an even worse prognosis than CCC, with a typical survival of ~6 months or less. Women are affected much more commonly than men (4:1), unlike HCC or CCC, and GB cancer occurs more frequently than CCC. Most patients have a history of antecedent gallstones, but very few patients with gallstones develop GB cancer (~0.2%). GB cancer presents similarly to CCC and is often diagnosed unexpectedly during gallstone or cholecystitis surgery. Presentation is typically that of chronic cholecystitis, chronic right upper quadrant pain, and weight loss. Useful but nonspecific serum markers include CEA and CA 19-9. CT scans or MRCP typically reveal a GB mass. The mainstay of treatment is surgical, either simple or radical cholecystectomy for stage I or II disease, respectively. Survival rates are near 100% at 5 years for stage I, and range from 60–90% at 5 years for stage II. More advanced GB cancer has worse survival, and many patients are unresectable. Adjuvant radiotherapy, used in the presence of local lymph node disease, has not been shown to enhance survival. Chemotherapy is not useful in advanced or metastatic GB cancer.

CARCINOMA OF THE AMPULLA OF VATER

This tumor arises within 2 cm of the distal end of the common bile duct and is mainly (90%) an adenocarcinoma. Locoregional lymph nodes are commonly involved (50%), and the liver is the most frequent site for metastases. The most common clinical presentation is jaundice, and many patients also have pruritus, weight loss, and epigastric pain. Initial evaluation is performed with an abdominal ultrasound to assess vascular involvement, biliary dilation, and liver lesions. This is followed by a CT scan or MRI and especially MRCP. The most effective therapy is resection by pylorus-sparing pancreaticoduodenectomy, an aggressive procedure resulting in better survival rates than with local resection. Survival rates are ~25% at 5 years in operable patients with involved lymph nodes and ~50% in patients without involved nodes. Unlike CCC, approximately 80% of patients are thought to be resectable at diagnosis. Adjuvant chemotherapy or radiotherapy has not been shown to enhance survival. For metastatic tumors, chemotherapy is currently experimental.

TUMORS METASTATIC TO THE LIVER

These are predominantly from colon, pancreas, and breast primary tumors but can originate from any organ primary. Ocular melanomas are prone to liver metastasis. Tumor spread to the liver normally carries a poor prognosis for that tumor type. Colorectal and breast hepatic metastases were previously treated with continuous hepatic arterial infusion chemotherapy. However, more effective systemic drugs for each of these two cancers, especially the addition of oxaliplatin to colorectal cancer regimens, have reduced the use of hepatic artery infusion therapy. In a large randomized study of systemic versus infusional plus systemic chemotherapy for resected colorectal metastases to the liver, the patients receiving infusional therapy had no survival advantage, mainly due to extrahepatic tumor spread. ^{90}Yttrium resin beads are approved in the United States for treatment of colorectal hepatic metastases. The role of this modality, either alone or in combination with chemotherapy, is being evaluated in many centers. Palliation may be obtained from chemoembolization, PEI, or RFA.

BENIGN LIVER TUMORS

Three common benign tumors occur and all are found predominantly in women. They are *hemangiomas, adenomas,* and *focal nodular hyperplasia* (FNH). FNH is typically benign, and usually no treatment is needed. Hemangiomas are the most common and are entirely benign. Treatment is unnecessary unless their expansion causes symptoms. Adenomas are associated with contraceptive hormone use. They can cause pain and can bleed or rupture, causing acute problems. Their main interest for the physician is a low potential for malignant change and a 30% risk of bleeding. For this reason, considerable effort has gone into differentiating these three entities radiologically. On discovery of a liver mass, patients are usually advised to stop taking sex steroids, because adenoma regression may then occasionally occur. Adenomas can often be large masses ranging from 8–15 cm. Due to their size and definite, but low, malignant potential and potential for bleeding, adenomas are typically resected. The most useful diagnostic differentiating tool is a triphasic CT scan performed with HCC fast bolus protocol for arterial-phase imaging, together with subsequent delayed venous-phase imaging. Adenomas usually do not appear on