

Percutaneous Biliary Drainage in Benign and Malignant Biliary Obstruction
EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
1. Hortobagyi GN. Treatment of breast cancer. <i>N Engl J Med</i> 1998; 339(14):974-984.	7	N/A	Review epidemiology, biology, diagnostic approaches and treatment of breast cancer.	Diagnostic and therapeutic approaches have improved. Early diagnosis of primary breast cancer reduces the risk of death by 30%.	3
2. Rougier P, Van Cutsem E, Bajetta E, et al. Randomised trial of irinotecan versus fluorouracil by continuous infusion after fluorouracil failure in patients with metastatic colorectal cancer. <i>Lancet</i> 1998; 352(9138):1407-1412.	1	267	Compare irinotecan with second-line fluorouracil by continuous infusion after fluorouracil failure in patients with metastatic colorectal cancer.	Survival at 1-year was increased from 32% in the fluorouracil group to 45% in the irinotecan group. Median progression-free survival: <ul style="list-style-type: none"> • .2 months (irinotecan) • 2.9 months (fluorouracil) Median pain-free survival: <ul style="list-style-type: none"> • 10.3 months(irinotecan) • 8.5 months (fluorouracil) 	2
3. Feydy A, Vilgrain V, Denys A, et al. Helical CT assessment in hilar cholangiocarcinoma: correlation with surgical and pathologic findings. <i>AJR</i> 1999; 172(1):73-77.	10	29 18 excluded	To assess the usefulness of helical CT in the presurgical evaluation of hilar cholangiocarcinoma.	Helical CT aids in tumor localization and in assessment of parenchymal, biliary intrahepatic and portal involvement in hilar cholangiocarcinoma. However, helical CT is not effective in the assessment of biliary extrahepatic, arterial, and lymph node involvement.	3
4. Fulcher AS, Turner MA. HASTE MR cholangiography in the evaluation of hilar cholangiocarcinoma. <i>AJR</i> 1997; 169(6):1501-1505.	14	6	Prospective studies to determine the value of MR cholangiography using the half-Fourier acquisition single-shot turbo spin-echo (HASTE) sequence in the examination of patients with hilar cholangiocarcinoma.	HASTE MR cholangiography is a useful, noninvasive adjunct to other imaging techniques, particularly MRI.	4
5. Hann LE, Greatrex KV, Bach AM, Fong Y, Blumgart LH. Cholangiocarcinoma at the hepatic hilus: sonographic findings. <i>AJR</i> 1997; 168(4):985-989.	9	39	To characterize US findings in patients with cholangiocarcinoma at the hepatic hilus and to compare findings with surgical and pathologic findings.	<ul style="list-style-type: none"> • Ductal masses in 34 patients (87%). • Masses were isoechoic in 22 patients (65%), hypoechoic in 7 (21%), and hyperechoic in 5 (15%). • Extent of bile duct involvement; 34 cases (87%). • Portal vein involvement by tumor; 20 patients (51%). • Occluded portal veins; 13 cases. • Encased portal veins without occlusion; 7 cases. • Klatskin tumors can be revealed by US. 	3

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6. Freeman ML, Overby C. Selective MRCP and CT-targeted drainage of malignant hilar biliary obstruction with self-expanding metallic stents. <i>Gastrointest Endosc</i> 2003; 58(1):41-49.	10	35	Prospective study to evaluate outcomes of selective MRCP and CT-targeted drainage with self-expanding metallic stents.	<ul style="list-style-type: none"> Initial metallic stents were clinically effective in 27 (77%). Median patency of first metallic stents was 8.9 months for patients with primary bile duct tumors and 5.4 months for all patients. Unilateral metallic stent placement by using MRCP and/or CT provides safe and effective palliation in most patients with malignant hilar biliary obstruction. 	3
7. Speer AG, Cotton PB, Russell RC, et al. Randomized trial of endoscopic versus percutaneous stent insertion in malignant obstructive jaundice. <i>Lancet</i> 1987; 2(8550):57-62.	1	75	Randomized trial to compare endoscopic with percutaneous stent insertion in malignant obstructive jaundice.	Endoscopic method had a significantly higher success rate (81% vs 61%, P=0.017) and a significantly lower 30-day mortality (15% vs 33%, P=0.016).	2
8. Van Leeuwen DJ, Huijbregtse K, Tytgat GN. Carcinoma of the hepatic confluence 25 years after Klatskin's description: diagnosis and endoscopic management. <i>Semin Liver Dis</i> 1990; 10(2):102-113.	7	N/A	Review current diagnostic and endoscopic management of biliary hepatic confluence (Klatskin).	Significant progress has been made regarding accurate diagnosis of hilar obstruction and recognition of therapeutic options.	4
9. Kosuge T, Yamamoto J, Shimada K, Yamasaki S, Makuuchi M. Improved surgical results for hilar cholangiocarcinoma with procedures including major hepatic resection. <i>Ann Surg</i> 1999; 230(5):663-671.	13	107	Retrospective analysis to evaluate the long-term outcome of aggressive surgery incorporating hepatic resection and systematic nodal dissection for advanced carcinoma involving the hepatic hilus.	<ul style="list-style-type: none"> 60% of patients with resectional surgery had stage IVA or IVB disease and 92.3% of them underwent major hepatectomies. Estimated 5-year survival rate after resection was 34.8. Nodal involvement; 44.6% of the resections. Hepatectomy and systematic nodal dissection gave a good chance of prolonged survival for patients with carcinoma involving the hepatic hilus. 	2
10. Nimura Y, Kamiya J, Kondo S, et al. Aggressive preoperative management and extended surgery for hilar cholangiocarcinoma: Nagoya experience. <i>J Hepatobiliary Pancreat Surg</i> 2000; 7(2):155-162.	3	177	Retrospective study on surgical resection in hilar cholangiocarcinoma after relieving jaundice by single or multiple percutaneous transhepatic biliary drainage (PTBD) followed by percutaneous transhepatic cholangioscopy and/or percutaneous trans-hepatic portal vein embolization.	Curative resection after aggressive preoperative management is recommended as a reasonable surgical approach.	2

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11. Sugiura Y, Nakamura S, Iida S, et al. Extensive resection of the bile ducts combined with liver resection for cancer of the main hepatic duct junction: a cooperative study of the Keio Bile Duct Cancer Study Group. <i>Surgery</i> 1994; 115(4):445-451.	13	158	To determine whether extensive resection of the bile ducts combined with liver resection is a feasible and valid procedure for cancer of the main hepatic duct junction.	<ul style="list-style-type: none"> 83 (53%) of the patients underwent resection, with 7 (8.4%) postoperative deaths. 5-year survival rate 20%. 5 years; 12 patients (3/12 patients were doing well after 10years). Cancer of the main hepatic duct junction has become a curable disease. 	3
12. Kimmings AN, van Deventer SJ, Obertop H, Rauws EA, Huibregtse K, Gouma DJ. Endotoxin, cytokines, and endotoxin binding proteins in obstructive jaundice and after preoperative biliary drainage. <i>Gut</i> 2000; 46(5):725-731.	13	15	To study endotoxaemia and the subsequent inflammatory response in obstructive jaundiced patients and after endoscopic biliary drainage (EBD).	<ul style="list-style-type: none"> Drainage reduced bilirubin from 252.5-45.1 micromol/l. Endotoxaemia was detected (4.3 pg/ml) which was not affected after drainage (4.5 pg/ml). Serum interleukin 8 (IL-8) and endotoxin binding proteins were increased in jaundice and reduced after drainage. 	3
13. Padillo FJ, Andicoberry B, Muntane J, et al. Factors predicting nutritional derangements in patients with obstructive jaundice: multivariate analysis. <i>World J Surg</i> 2001; 25(4):413-418.	13	46 obstructive jaundice patients	Prospective study to analyze the factors influencing nutritional derangements in patients with obstructive jaundice.	<ul style="list-style-type: none"> 22 (48%) obstructive jaundice patients had malnutrition. Malnourished patients had higher serum bilirubin levels, longer duration of jaundice, and higher plasma levels of cholecystokinin (CCK), alanine aminotransferase (ALT), endotoxin, and tumor necrosis factor-alpha than those without malnutrition. Intensity of the biliary obstruction correlated with increased plasma CCK levels; liver dysfunction and patient age determine nutritional alterations. 	2
14. Hatfield AR, Tobias R, Terblanche J, et al. Preoperative external biliary drainage in obstructive jaundice. A prospective controlled clinical trial. <i>Lancet</i> 1982; 2(8304):896-899.	1	57	Prospective study on preoperative external biliary drainage in obstructive jaundice patients.	<ul style="list-style-type: none"> Perioperative mortality <ul style="list-style-type: none"> 4/28 (14%) in drainage group, 4/27 (15%) in nondrainage group. No advantage with routine preoperative external biliary drainage before surgery for obstructive jaundice. 	2
15. McPherson GA, Benjamin IS, Hodgson HJ, Bowley NB, Allison DJ, Blumgart LH. Pre-operative percutaneous transhepatic biliary drainage: the results of a controlled trial. <i>Br J Surg</i> 1984; 71(5):371-375.	1	65	To assess results of a preoperative percutaneous drainage controlled trial.	<p>Mortality for laparotomy:</p> <ul style="list-style-type: none"> Laparotomy 19%, Drainage plus laparotomy 32%. <p>PTBD is dangerous in high risk patients.</p>	2

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16. Pitt HA, Gomes AS, Lois JF, Mann LL, Deutsch LS, Longmire WP, Jr. Does preoperative percutaneous biliary drainage reduce operative risk or increase hospital cost? <i>Ann Surg</i> 1985; 201(5):545-553.	13	37 preoperative PTD 38 no preoperative drainage	Prospective, randomized study to determine the effect of preoperative percutaneous transhepatic drainage (PTD) on operative mortality, morbidity, hospital stay, and hospital cost.	30 day mortality: <ul style="list-style-type: none"> • 8.1% for preoperative PTD. • 5.3% for no preoperative drainage. Overall morbidity: <ul style="list-style-type: none"> • 57% for preoperative PTD. • 53% for no preoperative drainage. Total hospital stay: <ul style="list-style-type: none"> • 31.4 days for preoperative PTD. • 23.1 days for no preoperative drainage. Preoperative PTD does not reduce operative risk but does increase hospital cost and, therefore, should not be performed routinely.	2
17. Sewnath ME, Birjmohun RS, Rauws EA, Huibregtse K, Obertop H, Gouma DJ. The effect of preoperative biliary drainage on postoperative complications after pancreaticoduodenectomy. <i>J Am Coll Surg</i> 2001; 192(6):726-734.	3a	311	To evaluate effect of preoperative biliary drainage on postoperative complications after pancreaticoduodenectomy (PD).	No significant difference in overall morbidity between patients with and without preoperative biliary drainage (50% and 55%, respectively). Preoperative biliary drainage did not influence the incidence of postoperative complications, and should not be used routinely.	1
18. Lygidakis NJ, van der Heyde MN, Lubbers MJ. Evaluation of preoperative biliary drainage in the surgical management of pancreatic head carcinoma. <i>Acta Chir Scand</i> 1987; 153(11-12):665-668.	3b	38	To evaluate preoperative biliary drainage in the surgical management of pancreatic head carcinoma by comparing group A (preoperative biliary drainage) to group B (no preoperative biliary drainage).	<ul style="list-style-type: none"> • Interval from admission to operation averaged 15 days in group A and 4 days in group B. • In group B, the intrabiliary pressure was higher than in group A and was associated with heightened incidence of biliary infection, bacteremia and intraoperative bleeding. • Intergroup difference in incidence of early complications was statistically significant. • Findings support value of preoperative biliary drainage in patients who are candidates for surgical treatment of carcinoma of the pancreatic head. 	2

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19. Marcus SG, Dobryansky M, Shamamian P, et al. Endoscopic biliary drainage before pancreaticoduodenectomy for periampullary malignancies. <i>J Clin Gastroenterol</i> 1998; 26(2):125-129.	13	182 52 malignant obstructive jaundice (22 preoperative EBD, and 30 were not drained) 83 excluded 43 biliary drainage 4 jaundice with benign pathology	Retrospective review of patients' records to evaluate the influence of preoperative EBD on morbidity after PD for malignant biliary obstruction.	<ul style="list-style-type: none"> Length of postoperative hospitalization for patients undergoing EBD was 13.5 days, compared with 19 days for patients who were not drained (P=0.02). Patients who were not drained had more overall complications (P=0.054). EBD before PD significantly reduced the length of postoperative hospitalization and was associated with less postoperative morbidity. 	2
20. Trede M, Schwall G. The complications of pancreatectomy. <i>Ann Surg</i> 1988; 207(1):39-47.	13	235 partial (Whipple) and 52 pancreatectomies performed for pancreatic and periampullary tumors (181 patients) and complicated chronic pancreatitis (104 patients).	To analyze the complications of pancreatectomy.	<ul style="list-style-type: none"> Overall operative and hospital mortality rate was 3.1%. Most frequent and dangerous were complications at or around the pancreaticojejunal anastomosis. 	2

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21. Garcia-Plata E, Seco JL, de la Plaza M, et al. [Influence of preoperative biliary drainage on postoperative morbidity and mortality after pancreatoduodenectomy]. <i>Cir Esp</i> 2005; 77(4):203-207.	3b	58	Retrospective analysis to examine relationship between preoperative biliary drainage and postoperative complications in patients with periampullary tumors who underwent pancreatoduodenectomy.	Biliary drainage (25.8%) before pancreatoduodenectomy was associated with more frequent biliary and pancreatic anastomotic leakage (60% with drainage vs 20.9% without drainage). Higher postoperative morbidity and greater mean postoperative length of hospital stay (33.3 days with drainage vs 21.6 without drainage). No significant difference was found between the two groups in postoperative mortality at 30 days (13.7%).	3
22. Hochwald SN, Burke EC, Jarnagin WR, Fong Y, Blumgart LH. Association of preoperative biliary stenting with increased postoperative infectious complications in proximal cholangiocarcinoma. <i>Arch Surg</i> 1999; 134(3):261-266.	13	71	Retrospective review to evaluate the effect of preoperative biliary stenting on bacterobilia and infectious complications following surgical treatment of proximal cholangiocarcinoma.	Patients with stents had: <ul style="list-style-type: none"> • Significantly lower bilirubin level (P=.005). • Significantly increased risk for bacterobilia (P=.001) and infectious complications (P=.03). • No increased risk for noninfectious complications, length of hospital stay, or mortality. 	2
23. Jagannath P, Dhir V, Shrikhande S, Shah RC, Mullerpatan P, Mohandas KM. Effect of preoperative biliary stenting on immediate outcome after pancreaticoduodenectomy. <i>Br J Surg</i> 2005; 92(3):356-361.	13	144	To examine the effects of preoperative biliary stenting on early outcome after PD.	<ul style="list-style-type: none"> • Positive intraoperative bile culture was associated with higher morbidity and mortality rates. • Positive culture in the stented group was related to stent complications and duration of stenting. • Uncomplicated stenting was not associated with increased morbidity or mortality. 	2
24. Pivoski SP, Karpeh MS, Jr., Conlon KC, Blumgart LH, Brennan MF. Association of preoperative biliary drainage with postoperative outcome following pancreaticoduodenectomy. <i>Ann Surg</i> 1999; 230(2):131-142.	13	240	Analysis of PD cases to determine whether preoperative biliary instrumentation and preoperative biliary drainage are associated with increased morbidity and mortality rates after PD.	Preoperative biliary drainage is associated with increased morbidity and mortality rates in patients undergoing PD.	2
25. Saleh MM, Norregaard P, Jorgensen HL, Andersen PK, Matzen P. Preoperative endoscopic stent placement before pancreaticoduodenectomy: a meta-analysis of the effect on morbidity and mortality. <i>Gastrointest Endosc</i> 2002; 56(4):529-534.	11	8 retrospective studies 2 prospective randomized controlled trials	Meta-analysis to investigate the effect on postoperative outcome of preoperative biliary drainage by endoscopic biliary stent placement in jaundiced and peripapillary pancreatic tumor patients.	No evidence was found of either a positive or adverse effect of preoperative endoscopic biliary stent placement on the outcome of surgery in patients with pancreatic cancer.	2

* See Last Page for Key

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26. Wagner HJ, Knyrim K, Vakil N, Klose KJ. Plastic endoprosthesis versus metal stents in the palliative treatment of malignant hilar biliary obstruction. A prospective and randomized trial. <i>Endoscopy</i> 1993; 25(3):213-218.	1	20	Prospective, randomized trial to compare plastic endoprosthesis and metal stents in the palliative treatment of malignant hilar biliary obstruction.	<ul style="list-style-type: none"> • Early stent failure (<30 days) occurred in 2 patient's of the plastic stent group. • Long-term (>30 days), stent failure was observed in 50% of the plastic group and 18.2% of the metal stent group. All differences were not statistically significant. • Metal stent offers higher success rates, higher patency rates and is cost-effective compared to plastic stent. 	2
27. Yeoh KG, Zimmerman MJ, Cunningham JT, Cotton PB. Comparative costs of metal versus plastic biliary stent strategies for malignant obstructive jaundice by decision analysis. <i>Gastrointest Endosc</i> 1999; 49(4 Pt 1):466-471.	15	N/A	To compare costs of 3 strategies: <ul style="list-style-type: none"> • Plastic stent, with exchange on occlusion. • Metal stent initially, with coaxial plastic stent insertion in the event of occlusion. • Plastic stent initially, with metal stent exchange in the event of occlusion. 	<ul style="list-style-type: none"> • Choice of stent is dependant on relative local cost of ERCP and metal stents and prognosis of patient. • Plastic stents are useful in patients surviving <4 months, while metal stents are more economical for patients with longer survival. 	3
28. Abraham NS, Barkun JS, Barkun AN. Palliation of malignant biliary obstruction: a prospective trial examining impact on quality of life. <i>Gastrointest Endosc</i> 2002; 56(6):835-841.	13	50	Prospective study to determine clinical characteristics that have impact on quality-of-life in patients with malignant biliary obstruction, and to quantify changes in the quality-of-life of patients with malignant biliary obstruction after successful decompression with a plastic stent.	<ul style="list-style-type: none"> • Weight loss and hyperbilirubinemia are predictive of poor quality of life before endoscopic decompression. • Successful biliary drainage after stent is associated with improvements in quality of life, although this is less true among patients with baseline bilirubin >13 mg/dL. 	3
29. Lee MJ, Dawson SL, Mueller PR, et al. Failed metallic biliary stents: causes and management of delayed complications. <i>Clin Radiol</i> 1994; 49(12):857-862.	13	69	To describe the incidence, management and long-term outcome of metal stent failure in patients with malignant biliary obstruction.	<ul style="list-style-type: none"> • Adequate peripheral purchase in the biliary tree and overstenting are necessary to prevent tumor overgrowth when stenting hilar lesions. • Development of stent occlusion due to tumor overgrowth indicates limited survival. • Internal/external catheters are preferred over further metal stents for palliation. 	3

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30. Rossi P, Bezzi M, Rossi M, et al. Metallic stents in malignant biliary obstruction: results of a multicenter European study of 240 patients. <i>J Vasc Interv Radiol</i> 1994; 5(2):279-285.	13	240	Retrospective study to analyze clinical efficacy of different metallic stents in the palliative treatment of patients with neoplastic obstructive jaundice.	<ul style="list-style-type: none"> • 25- and 50-week survival rates were 42% and 16%, respectively. • 25-week patency rate was higher for the nitinol Strecker stents and the Wallstents (78% and 67%, respectively) than for the Z stents and the tantalum Strecker stents (30% and 20%, respectively) (P<.01 and P<.001, respectively). • Wallstent and the nitinol Strecker stents were the most effective for long-term palliation. 	2
31. Salomonowitz EK, Adam A, Antonucci F, Stuckmann G, Zollikofer CL. Malignant biliary obstruction: treatment with self-expandable stainless steel endoprosthesis. <i>Cardiovasc Intervent Radiol</i> 1992; 15(6):351-355.	3a	80	To analyze treatment of malignant biliary obstruction with self expandable stainless steel endoprosthesis.	Self-expandable stainless steel endoprosthesis provide good palliation in patients with malignant obstructive jaundice.	2
32. Hausegger KA, Thurnher S, Bodendorfer G, et al. Treatment of malignant biliary obstruction with polyurethane-covered Wallstents. <i>AJR</i> 1998; 170(2):403-408.	4	30	Study to determine the safety, efficacy, and performance of polyurethane-covered Wallstents in the treatment of malignant biliary obstruction.	30-day mortality rate 20%. 11 stent occlusions occurred during follow-up. The patency rates after 1, 3, 6, and 12 months were 96%, 69%, 47%, and 31%, respectively.	3
33. Rossi P, Bezzi M, Salvatori FM, Panzetti C, Rossi M, Pavia G. Clinical experience with covered wallstents for biliary malignancies: 23-month follow-Up. <i>Cardiovasc Intervent Radiol</i> 1997; 20(6):441-447.	3a	21	23 month follow-up to evaluate the effectiveness of partially covered metallic Wallstents to prevent tumoral ingrowth in patients with neoplastic obstruction of the biliary tract.	<ul style="list-style-type: none"> • Primary patency 46.8% and 24.6% (ranging from 7 to 23 months). • Assisted patency 66.3% and 59% at 6 months and 23 months, respectively. • Covered metallic stents are effective and may produce improved survival in patients with malignant biliary obstruction (27. 8% at 23 months). 	3
34. Ginsberg G, Cope C, Shah J, et al. In vivo evaluation of a new bioabsorbable self-expanding biliary stent. <i>Gastrointest Endosc</i> 2003; 58(5):777-784.	5	8 animals	To evaluate a new bioabsorbable biliary stent (BioStent) in a porcine model. Stent function and biotolerance were assessed by cholangiography, serum bilirubin, and necropsy for histopathology performed in pairs at 2, 4, 6, and 12 months.	BioStent can be deployed endoscopically, is self-expanding, is visualized radiographically, and remains patent up to 6 months.	4
35. Hatzidakis A, Krokidis M, Kalbakis K, Romanos J, Petrakis I, Gourtsoyiannis N. ePTFE/FEP-covered metallic stents for palliation of malignant biliary disease: can tumor ingrowth be prevented? <i>Cardiovasc Intervent Radiol</i> 2007; 30(5):950-958.	4	36	To determine the application and clinical effectiveness of ePTFE/FEP covered metallic stents for palliation of malignant biliary disease, and to evaluate the efficiency of stent coverage in preventing tumor ingrowth.	Primary patency rates; 100%, 55.5%, and 25% at 3, 6, and 12 months, respectively, Assisted patency rate 100% at 12 months. ePTFE/FEP covered metallic stents are safe and effective for palliation of malignant biliary disease.	3

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36. Schoder M, Rossi P, Uflacker R, et al. Malignant biliary obstruction: treatment with ePTFE-FEP- covered endoprosthesis initial technical and clinical experiences in a multicenter trial. <i>Radiology</i> 2002; 225(1):35-42.	2	42	Prospective study to determine and present the initial technical and clinical results of using ePTFE/FEP covered biliary endoprosthesis to treat malignant biliary obstruction.	<ul style="list-style-type: none"> • 30 mortality rate was 20% (8 of 41 patients), and median survival time was 146 days. • Primary patency rates at 3, 6, and 12 months were 90%, 76%, and 76%, respectively. • ePTFE-FEP is safe and potentially clinically effective. 	2
37. Jeng KS. Treatment of intrahepatic biliary stricture associated with hepatolithiasis. <i>Hepatogastroenterology</i> 1997; 44(14):342-351.	7	N/A	Review treatment of biliary stricture.	Recommend multimodal treatment and systemic approach to improve results. For recurrent or residual cases, PTCSL becomes the mainstay of treatment.	4
38. Maccioni F, Rossi M, Salvatori FM, Ricci P, Bezzi M, Rossi P. Metallic stents in benign biliary strictures: three-year follow-up. <i>Cardiovasc Intervent Radiol</i> 1992; 15(6):360-366.	3a	18	3 year follow-up of metallic stents placement in patients with benign biliary strictures (BBS).	Overall patency rate, at 3-year follow-up was 68.7%. Satisfactory long-term results. Metallic stents may represent the only long-term treatment available for maintaining bile flow in selected patients.	3
39. Yoon HK, Sung KB, Song HY, et al. Benign biliary strictures associated with recurrent pyogenic cholangitis: treatment with expandable metallic stents. <i>AJR</i> 1997; 169(6):1523-1527.	3a	23 patients 26 stents	To determine the long-term effectiveness of expandable metallic stents in BBS associated with recurrent pyogenic cholangitis.	<ul style="list-style-type: none"> • Primary stent patency for 24 stents was 34 months (range, 3-58 months). • Primary stent patency of the Gianturco-Rosch Z and Strecker stents was 50 and 10 months, respectively (p<.05). • Primary stent patency for the intrahepatic and extrahepatic ducts was 50 and 18 months, respectively (P=.05). • Primary patency rates for all stents at 6, 12, 24, and 36 months were 92%, 75%, 67%, and 46%, respectively. 	3
40. Lopez RR, Jr., Cosenza CA, Lois J, et al. Long-term results of metallic stents for benign biliary strictures. <i>Arch Surg</i> 2001; 136(6):664-669.	13	15	To examine long-term results of metallic stents for the treatment of BBS.	<ul style="list-style-type: none"> • Mean patency rate was 30.6 months (range, 7-120 months). • Surgical repair remains the treatment of choice for BBS. • Metallic stents should only be considered for poor surgical candidates, intrahepatic biliary strictures, or failed attempts at surgical repair. 	3
41. Burke DR, Lewis CA, Cardella JF, et al. Quality improvement guidelines for percutaneous transhepatic cholangiography and biliary drainage. <i>J Vasc Interv Radiol</i> 2003; 14(9 Pt 2):S243-246.	15	N/A	Quality improvement guidelines for percutaneous transhepatic cholangiography and biliary drainage. Purpose of guidelines is to assess percutaneous biliary procedures in quality improvement programs.	Recommended overall procedure threshold for all major complications of percutaneous transhepatic biliary drainage is 10%.	4

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42. Baccarani U, Risaliti A, Zoratti L, et al. Role of endoscopic retrograde cholangiopancreatography in the diagnosis and treatment of biliary tract complications after orthotopic liver transplantation. <i>Dig Liver Dis</i> 2002; 34(8):582-586.	13	132	To analyze endoscopic diagnosis and treatment of biliary tract complications after liver transplantation.	<ul style="list-style-type: none"> Endoscopic was done on 30 patients (23%). Overall incidence of biliary complications confirmed by endoscopic retrograde was 17% (25 cases). Endoscopic was negative in 5 cases (16%). Biliary complications were successfully treated by endoscopy in 84% of cases (21 out of 25 patients). Endoscopic is a safe and effective approach for diagnosis and treatment of biliary-related complications after liver transplantation. 	2
43. Fleck A, Zanotelli ML, Meine M, et al. Biliary tract complications after orthotopic liver transplantation in adult patients. <i>Transplant Proc</i> 2002; 34(2):519-520.	13	150 patients 157 OLT	Review medical reports to analyze biliary complications after orthotopic liver transplantation (OLT).	<ul style="list-style-type: none"> 23 patients (15.3%) had some type of biliary complications. Most common early complication was biliary leak. Stenting of the biliary tract is safe and effective in the long-term, avoiding more invasive surgical procedures. 	3
44. Funaki B, Zaleski GX, Straus CA, et al. Percutaneous biliary drainage in patients with nondilated intrahepatic bile ducts. <i>AJR</i> 1999; 173(6):1541-1544.	3a	130	To evaluate the technical success and complications of PTBD in patients with nondilated intrahepatic bile ducts.	<ul style="list-style-type: none"> Percutaneous biliary drainage (PBD) was successful in 117 (90%). Overall complication rate was 9%. PBD can be performed with high success rate. 	2
45. Rieber A, Brambs HJ, Lauchart W. The radiological management of biliary complications following liver transplantation. <i>Cardiovasc Intervent Radiol</i> 1996; 19(4):242-247.	4	22	To analyze outcomes of diagnostic percutaneous transhepatic cholangiography (PTC) and PTD in biliary complications.	<ul style="list-style-type: none"> PTC revealed anastomotic in 6 patients and nonanastomotic biliary strictures in 6 patients. Patients with anastomotic strictures had better favorable outcome. 	3
46. Righi D, Cesarani F, Muraro E, Gazzera C, Salizzoni M, Gandini G. Role of interventional radiology in the treatment of biliary strictures following orthotopic liver transplantation. <i>Cardiovasc Intervent Radiol</i> 2002; 25(1):30-35.	3a	619	To evaluate the efficacy and safety of percutaneous treatment of biliary strictures following OLT.	<ul style="list-style-type: none"> 24 of 33 (73%) patients were stricture-free on US and MR cholangiography follow-up after 1 to 3 treatments. Percutaneous is effective and has a high success rate and should be considered before surgical interventions. 	2
47. Stratta RJ, Wood RP, Langnas AN, et al. Diagnosis and treatment of biliary tract complications after orthotopic liver transplantation. <i>Surgery</i> 1989; 106(4):675-683; discussion 683-674.	3	226	To analyze diagnosis and treatment of biliary tract complications after liver transplantation. Biliary tract reconstruction was via Roux limb choledochojejunostomy (n=144) or choledochocholedochostomy (n=118).	Although choledochocholedochostomy is more physiologic and expeditious, Roux-en-Y choledochojejunostomy remains a safe and versatile alternative and is the preferred method of reconstruction in select cases.	3

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EVIDENCE TABLE

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Strength of Evidence
48. Gunther RW, Schild H, Thelen M. Percutaneous transhepatic biliary drainage: experience with 311 procedures. <i>Cardiovasc Intervent Radiol</i> 1988; 11(2):65-71.	4	296	PBD performed in patients on 311 occasions with a fine-needle puncture technique.	Procedure is best for complicated biliary obstruction, palliative drainage, and endobiliary manipulations.	2
49. Lameris JS, Obertop H, Jeekel J. Biliary drainage by ultrasound-guided puncture of the left hepatic duct. <i>Clin Radiol</i> 1985; 36(3):269-274.	4	38	Biliary drainage under US guidance performed in patients with obstructive jaundice due to malignancy.	<ul style="list-style-type: none"> • Method of choice was puncture of the left lobar ducts (35 patients). • Successful US-guided punctures. • Delayed complications were cholangitis (10 patients) and bleeding (1 patient). 	3
50. Carrasco CH, Zornoza J, Bechtel WJ. Malignant biliary obstruction: complications of percutaneous biliary drainage. <i>Radiology</i> 1984; 152(2):343-346.	7	161	Review medical records of patients who had PBD for malignant biliary obstruction.	Higher occurrence of complications particularly of cholangitis. PBD carries a high risk of cholangitis in patients with cancer.	3
51. Chapman WC, Sharp KW, Weaver F, Sawyers JL. Tumor seeding from percutaneous biliary catheters. <i>Ann Surg</i> 1989; 209(6):708-713; discussion 713-705.	5 and 7	Case report 1 patient Literature review 17	A case report and literature review of tumor seeding from percutaneous biliary catheters.	13 of 18 patients had catheters placed for palliation, while 5 patients underwent preoperative drainage before definitive procedures, and 4 of these patients had undergone "curative" resections. 9 of 18 patients had biliary obstruction from cholangiocarcinoma, while 7 had primary pancreatic carcinoma.	4
52. Mueller PR, van Sonnenberg E, Ferrucci JT, Jr. Percutaneous biliary drainage: technical and catheter-related problems in 200 procedures. <i>AJR</i> 1982; 138(1):17-23.	4	200 biliary drainages	Analysis of technical and clinical components in PBD.	<ul style="list-style-type: none"> • Successful drainage occurred in 94% (188 of 200 procedures). • Severe acute periprocedural complications occurred in 16 (8%). • Minor periprocedural complications occurred in 39 (20%). • Significant delayed in-hospital complications with catheter function occurred in 22%. 	3
53. Audisio RA, Morosi C, Bozzetti F, et al. The outcome of cholangitis after percutaneous biliary drainage in neoplastic jaundice. <i>HPB Surg</i> 1993; 6(4):287-293.	3a	29	To evaluate factors affecting the outcome of cholangitis after PTBD in neoplastic jaundice.	PTBD-related cholangitis has a good chance of cure, low mortality rate and satisfactory 6 months median survival.	3
54. Libby ED, Leung JW. Prevention of biliary stent clogging: a clinical review. <i>Am J Gastroenterol</i> 1996; 91(7):1301-1308.	7	N/A	To review prevention of biliary stent blockage.	No results.	4

Evidence Table Key

Study Type Key

Numbers 1-7 are for studies of therapies while numbers 8-15 are used to describe studies of diagnostics.

1. Randomized Controlled Trial — Treatment
2. Controlled Trial
3. Observation Study
 - a. Cohort
 - b. Cross-sectional
 - c. Case-control
4. Clinical Series
5. Case reviews
6. Anecdotes
7. Reviews

8. Randomized Controlled Trial — Diagnostic
9. Comparative Assessment
10. Clinical Assessment
11. Quantitative Review
12. Qualitative Review
13. Descriptive Study
14. Case Report
15. Other (Described in text)

Strength of Evidence Key

- Category 1 - The conclusions of the study are valid and strongly supported by study design, analysis and results.
- Category 2 - The conclusions of the study are likely valid, but study design does not permit certainty.
- Category 3 - The conclusions of the study may be valid but the evidence supporting the conclusions is inconclusive or equivocal.
- Category 4 - The conclusions of the study may not be valid because the evidence may not be reliable given the study design or analysis.