

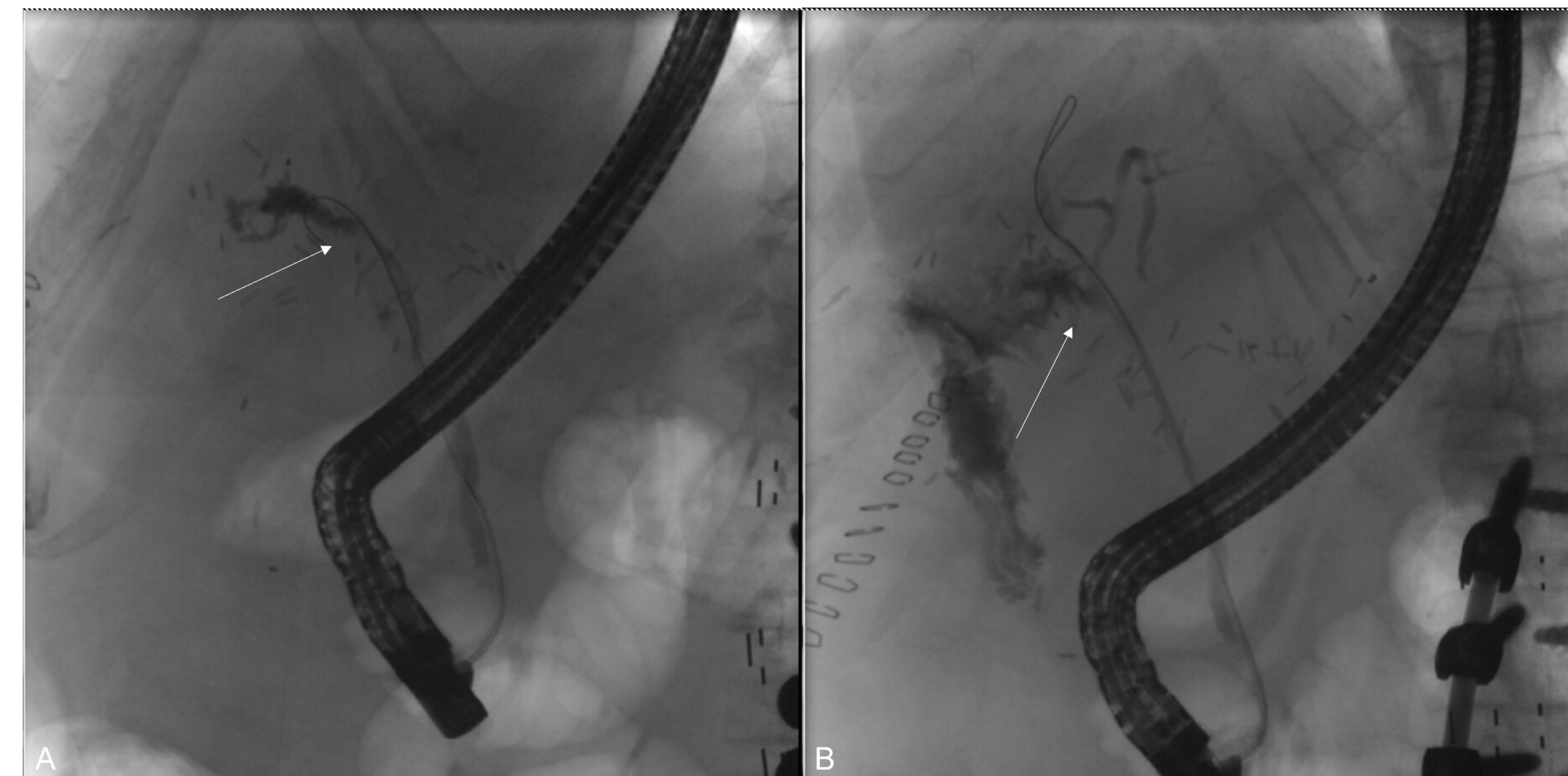
## Introduction

Post-hepatectomy bile leak (H-BL) can occur in up to 30% of cases and lead to higher post-operative morbidity. Endoscopic retrograde cholangiopancreatography (ERCP) is considered a good treatment option although current literature is limited to small cohort studies.

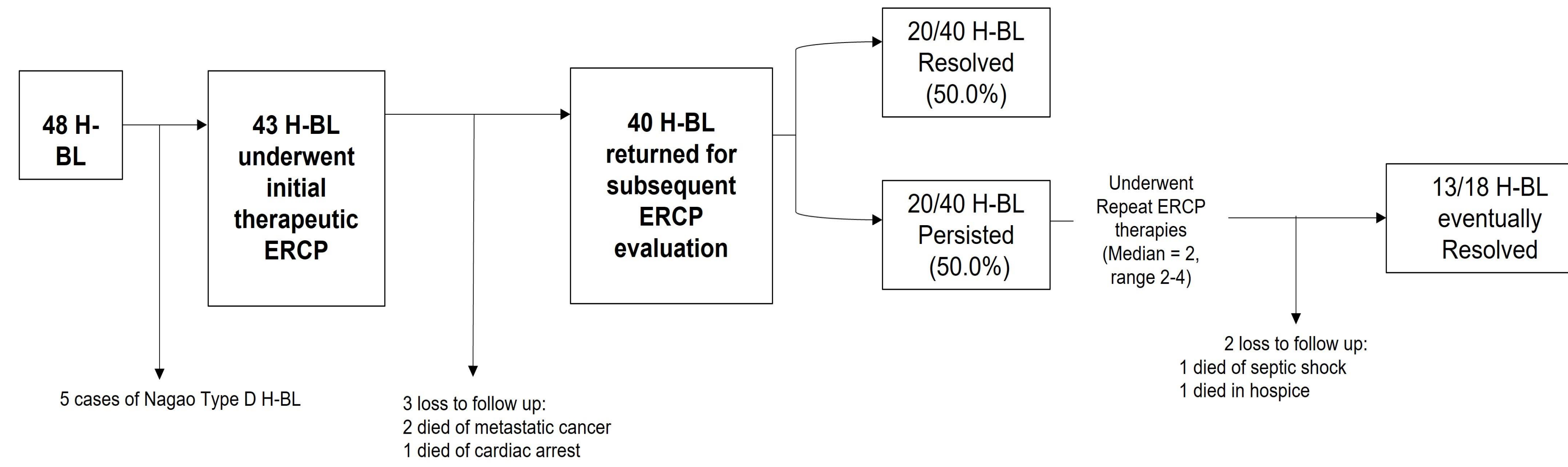
## Methods

We created a retrospective database of H-BL cases referred for ERCP between 2011 to 2021. Data collected included endoscopic reports, fluoroscopic imaging, patient demographics, type of H-BL and ERCP outcomes. A high-grade bile leak (HGBL) was defined as visualization of contrast extravasation from the bile duct before filling of intrahepatic biliary branches with contrast (Image 1). Initial ERCP failure was defined as persistence of H-BL seen on the 2nd ERCP evaluation.

**Image 1:** Example of Nagano type B high-grade bile leak from right hepatic duct post hepatectomy.



**Image 2:** Flowchart of the Study



**Table 1.** Univariate analysis of clinical factors for persistent H-BL after initial ERCP treatment (N=40)

Variables	Initial ERCP failure	OR (95% CI)	P value
<b>Patient Characteristics</b>			
Female	6/20 (30.0%)	0.25 (0.06 – 1.01)	0.051
Age 55 years old or more	9/20 (45.0%)	0.52 (0.13 – 2.02)	0.344
Median BMI (IQR)	26.0 (25.0, 32.0)	1.03 (0.94 – 1.13)	0.563
On diabetic treatment	4/17 (23.5%)	5.54 (0.55 – 55.49)	0.145
Malignancy as underlying diagnosis for hepatic resection	15/20	2.72 (0.57 – 12.91)	0.207
<b>Location and timing of ERCP Procedure</b>			
ERCP performed > 3 days	17/20 (85.0%)	0.88 (0.11 – 7.06)	0.906
<b>Bile leak characteristics</b>			
Nagano Type A*	1/20 (5.0%)	0.33 (0.03 – 3.55)	0.363
Nagano Type B	14/20 (70.0%)	0.85 (0.21 – 3.39)	0.813
Nagano Type C	5/20 (25.0%)	2.22 (0.44 – 11.18)	0.333
<b>High-grade bile leak</b>	15/20 (75.0%)	12.80 (2.55 – 64.37)	<b>0.002</b>
<b>Concomitant biloma present</b>	17/20 (85.0%)	7.33 (1.53 – 35.11)	<b>0.013</b>
Percutaneous abdominal drain present	16/20 (80.0%)	1.50 (0.34 – 6.59)	0.591
Presence of biliary stones	3/20 (15.0%)	0.53 (0.04 – 6.44)	0.619
Presence of biliary stricture	5/20 (25.0%)	1.56 (0.34 – 7.13)	0.565
<b>ERCP interventions</b>			
Biliary sphincterotomy performed	20/20 (100.0%)	200326 (0.00 – 5E274)	0.969
Biliary sphincterotomy alone	0	0.00 (0.00 – 43E213)	0.962
Bridging biliary stents	9/20 (45.0%)	2.36 (0.48 – 11.73)	0.293
Multiple biliary plastic stents	3/20 (15.0%)	0.47 (0.09 – 2.42)	0.367

## Results

In total, 48 cases of H-BL (30 for malignancy, 9 for liver abscess, 1 for large liver cyst) were referred for ERCP. None of them had hepaticojejunostomy. After excluding cases with transected bile ducts, 43 cases underwent initial therapeutic ERCP – 20/43 were HGBL involving the left or right hepatic duct (9/20), main extrahepatic duct (9/20) or peripheral intrahepatic ducts (2/20); in contrast, 23/40 low-grade leaks were mainly from peripheral intrahepatic ducts (16/23). 40 patients were able to return for their 2nd ERCP evaluation. Of these, 38 patients had received biliary endoscopic sphincterotomy (BES) with one or multiple plastic stents and 2 received only plastic biliary stents. 50% of H-BL resolved after initial ERCP and the rest underwent repeat ERCP interventions with eventual resolution of H-BL in 33/38 (86.8%) of cases (Image 2).

Univariate logistic regression analysis identified that high grade leak and presence of biloma were associated with significantly higher odds for H-BL persistence after initial ERCP (Table 1). On multivariate analysis, presence of a high-grade leak (OR 11.02, CI 1.58 – 76.78, p = 0.015) remained significant for persistent H-BL after initial ERCP therapy. Adverse events occurred in 3/40 (7.5%) cases after initial ERCP – 1 case of pancreatitis and 2 cases of cholangitis.

## Discussion

Our study suggests that ERCP remains an effective treatment for H-BL, although 50% of our cohort needed more than one ERCP. 15/20 of initial ERCP failures had underlying malignancy, which may have negatively affected healing (OR for initial ERCP 2.72 [0.57 – 12.91]), although this was not statistically significant. Patients with HGBL should undergo more persistent endoscopic therapy such as a longer stent indwell time.