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ORIGINAL ARTICLE

Surgical resection for hilar cholangiocarcinoma: experience improves resectability

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Abstract

Objectives: In hilar cholangiocarcinoma, resection provides the only opportunity for longterm survival. A US experience of hilar cholangiocarcinoma was examined to determine the effect of clinical experience on negative margin (R0) resection rates.

Methods: We conducted a retrospective analysis of 110 consecutive hilar cholangiocarcinoma patients presenting over an 18-year period. Analyses were performed using chi-squared, Wilcoxon rank sum and Kaplan–Meier methods, and multivariable Cox and logistic regression modelling.

Results: Of the 110 patients in the cohort, 59.1% were male and 90.9% were White. The median patient age was 64 years. A total of 59 (53.6%) patients underwent resection; 37 of these demonstrated R0. The 30-day mortality rate was 5.1%; the complication rate was 39.0%. The rate of resectability increased over time (36.4% vs. 70.9%; $P = 0.001$), as did the percentage of R0 resections (10.9% vs. 56.5%; $P < 0.001$). Of the 59 patients who underwent resection, 23 (39.0%) experienced recurrence. Multivariable Cox regression analysis identified resection margins [hazard ratio (HR) = 4.124 for positive vs. negative; $P = 0.002$] and type of operation (HR = 5.075 for exploration vs. resection; $P = 0.001$) as significant to survival.

Conclusions: Although R0 resection can be achieved in only a minority of patients, these patients have a reasonable chance of longterm survival. The last decade has seen a significant rise in rates of resectability of Klatskin's tumour at specialty centres.

Keywords

cholangiocarcinoma, Klatskin's tumour, resection, multivariate analysis

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Introduction

Early experiences with hilar cholangiocarcinoma, or Klatskin's tumour, were often discouraging.[1–5] However, despite poor overall outcomes in these series, there was sporadic evidence of longterm survival in patients in whom resection with negative margins (R0) could be achieved. The lack of effective chemotherapy or radiotherapy left surgical resection to represent the sole chance of long-term survival.[5–10] Inadequate understanding of hepatobiliary drainage led to local biliary resections of hilar cholangiocarcinoma that were plagued by multiple local tumour recurrences. This overly common outcome led to a nihilistic view of hilar cholangiocarcinoma.[9] In the late 1990s, select Japanese and American centres began to advocate a more aggressive approach to hilar cholangiocarcinoma involving a radical biliary resection with a segmental hepatic resection inclusive of segment I.[11–15] This approach resulted in dramatic improvements in survival and decreases in local tumour recurrence. To date, several centres have reported their experiences in hilar cholangiocarcinoma.[16–34] Renewed interest in the management of hilar cholangiocarcinoma combined with modern interventional radiology techniques makes this a timely study. Improvements in endoscopic and percutaneous biliary drainage, as well as portal vein embolization

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(PVE) for inadequate remnant liver after resection, have improved the armamentarium for successful resection of these tumours.[34–37] Here, we report our experience with 110 consecutive patients who underwent surgical exploration for hilar cholangiocarcinoma (Klatskin's tumour).

Materials and methods

From January 1992 to December 2010, 110 consecutive patients with hilar cholangiocarcinoma underwent surgical exploration at the University of Louisville or the University of Cincinnati. All data were collected through an institutional review board (IRB)-approved protocol at both institutions. Data were then analysed in a retrospective fashion. This analysis included patient demographics, and clinical, laboratory and radiologic evaluations, which were correlated with pathologic specimens and patient outcomes.

An initial assessment of these patients included laboratory testing and cross-sectional imaging, usually with triple-phase computed tomography (CT). Initial drainage and cytologic evaluations were performed through endoscopic retrograde cholangiography (ERCP) or percutaneous transhepatic cholangiography (PTC) with brushings. A recent addition to our patient evaluation process has been cholangioscopy. After diagnostic imaging, an aggressive approach to percutaneous drainage and PVE, where indicated to improve resection remnant, was adopted. During the placement of percutaneous transhepatic catheters, percutaneous liver biopsy was performed to elucidate the presence of cirrhosis. To adequately address hyperbilirubinaemia, a three-system method of drainage was advocated, in which a single catheter was placed in the left biliary radical and dual drainage was applied to the right anterior and right posterior biliary systems. Triple-phase CT imaging was used to evaluate potential post-resection remnant size and to assess the extent and potential resectability of the lesion. Magnetic resonance imaging (MRI) was used in selected cases; however, MRI was generally applied according to institutional experience and preference, and its use was rare overall. A remnant size of <1000 ml was generally considered as an indication to proceed with PVE. Portal vein embolization was carried out with a sealant material to avoid the use of coils. Coils were avoided to prevent stapler misfiring during resection. The extent of embolization was based on the collateral blood flow through segment IV. Complete embolization of segment IV is felt to improve the percentage of patients who demonstrate post-embolization growth. After embolization, patients were reimaged within 4–6 weeks. If future liver remnant hypertrophy was inadequate, patients were reimaged after an additional 2 weeks. With the exception of the recent addition of cholangioscopy, the preoperative workup procedure remained largely consistent throughout the study period. Preoperative criteria for unresectability have been previously described by Jarnagin *et al.*[29] and in general are related to unfitness for a major operation, extensive bilateral hepatic involvement and disseminated disease.

The final determination of resectability was made intraoperatively to exclude peritoneal or distant metastases not identified on preoperative imaging. Criteria for unresectability during exploration were: (i) peritoneal disease; (ii) bilateral liver involvement; (iii) inadequate hepatic reserve; (iv) main hepatic artery encasement with tumour, and (v) inadequate length of portal vein for vascular reconstruction. Intraoperative ultrasound (IOUS) is a critical component of intraoperative assessment, particularly in identifying intrahepatic metastases or advanced bilateral biliary involvement not identified on preoperative imaging.

Resection proceeded with mobilization of the hepatic bifurcation and division of the vasculature to the specimen side. In cases of vascular resection, primary anastamosis of redundant vasculature was preferred to the use of an inter-position graft. Lobar resection including removal of the caudate lobe was preferentially carried out concomitantly with local tumour resection. Margins from the hepatic substance and each of the biliary radicals were sent for intraoperative frozen section. R0 resection was defined as the provision of a final permanent section free of microscopic tumour. R1 resection was defined as the leaving of microscopically positive margins, and R2 resection was defined as the leaving of gross residual disease.

Outcomes for the first 55 patients (first-era group) and the most recent 55 patients (second-era group), respectively, were analysed and compared. Continuous and categorical variables were analysed using the Wilcoxon rank sum test and Fisher's exact test, respectively. Multivariable logistic regression was utilized to determine factors related to resectability and margin status. Survival was calculated using the Kaplan–Meier method and compared between groups using the log-rank test. Length of survival was calculated as the period from the date of initial operation to the date of death or last follow-up. Cox regression analysis was used to evaluate for independent predictors of outcome using survival as the dependent variable and factors found to be significant on univariate analysis as covariates. A significance level of $P < 0.05$ was set. All statistical analysis was performed using SAS Version 9.2 (SAS Institute, Inc., Cary, NC, USA).

Results

Patient presentation

Of the 110 consecutive patients evaluated for hilar cholangiocarcinoma, the majority were White males. Their median age was 64 years. The most common presenting symptoms were jaundice, weight loss and abdominal pain (Table 1). Biopsy in seven patients showed fibrotic or cirrhotic disease. Median laboratory values at presentation were: bilirubin, 6.0 mg/dl; alkaline phosphatase (ALP), 475 IU/l, and carbohydrate antigen 19-9 (CA19-9), 257.5.

Diagnostic imaging and preoperative staging

Of the 106 patients in whom preoperative brushings were performed, cytology was positive in 39 (36.8%). Five of the most recent 55 patients were deemed marginal candidates based on their marginal residual liver remnant and underwent PVE

Table 1 Patient characteristics and comparison by era

	All patients (*n* = 110)	Era 1 patients (*n* = 55)	Era 2 patients (*n* = 55)	*P*-value
Age, years, median (range)	64 (21–88)	62 (21–88)	66 (27–88)	0.072
Sex, *n* (%)				
Male	65 (59.1%)	32 (58.2%)	33 (60.0%)	
Female	45 (40.9%)	23 (41.8%)	22 (40.0%)	1.00
Race, *n* (%)				
White	100 (90.9%)	51 (92.7%)	49 (89.1%)	
African-American	8 (7.3%)	3 (5.5%)	5 (9.1%)	
Asian	1 (0.9%)	1 (1.8%)	0	
Hispanic	1 (0.9%)	0	1 (1.8%)	0.601
Weight loss, *n* (%)	57 (51.8%)	27 (49.1%)	30 (54.6%)	0.703
Pain, *n* (%)	24 (21.8%)	13 (23.6%)	11 (20.0%)	0.818
Jaundice, *n* (%)	91 (82.7%)	46 (83.6%)	45 (81.8%)	1.00
CT mass, *n* (%)	48 (46.6%)	28 (50.9%)	20 (41.7%)	0.423
Cirrhosis, *n* (%)	7 (6.4%)	2 (3.6%)	5 (9.1%)	0.438
PSC, *n* (%)	9 (8.2%)	2 (3.6%)	7 (12.7%)	0.161
Bilirubin, mg/dl, median (range)	6.0 (0.2–35.1)	4.1 (0.4–35.1)	8.3 (0.2–35.0)	0.080
ALP, IU/l, median (range)	475.0 (1–3 037)	544.0 (103–3 037)	425.0 (1–1 244)	0.086
CA19-9, median (range)	257.5 (5–45 000)	280.0 (5–45 000)	212.5 (15–30 484)	0.562
Positive brushings, *n* (%)	39 (36.8%)	14 (25.5%)	25 (49.0%)	**0.016**
PTC, *n* (%)	55 (50.0%)	18 (32.7%)	37 (62.3%)	**0.001**
PVE, *n* (%)	5 (4.6%)	0	5 (9.1%)	0.057
Lymph node invasion, *n* (%)	59 (53.6%)	39 (70.9%)	20 (36.4%)	**0.001**
Perineural invasion, *n* (%)	59 (60.2%)	39 (70.9%)	20 (46.5%)	**0.022**
Type of surgery, *n* (%)				
Resection	59 (53.7%)	20 (36.4%)	39 (70.9%)	
Exploration	51 (46.4%)	35 (63.6%)	16 (29.1%)	**0.001**
Lobar resection, *n* (%)	49 (44.5%)	15 (27.3%)	34 (61.8%)	**<0.001**
R0 resection, *n* (%)	37 (33.6%)	6 (10.9%)	31 (56.5%)	**<0.001**

CT, computed tomography; PSC, primary sclerosing cholangitis; ALP, alkaline phosphatase; PTC, percutaneous transhepatic cholangiography; PVE, portal vein embolization.
P-values refer to the comparison between Era 1 and Era 2. Values in bold are significant at <0.05.

(Table 1). Computed tomography scanning was performed in 109 patients and MRI was performed in 10. Percutaneous transhepatic cholangiography catheters were placed in 55 patients.

Operative morbidity and mortality

A total of 110 patients were explored for potential resection. Intra-operative findings precluded surgical resection in 51 patients. The remaining 59 (53.6%) patients underwent attempted curative resection. In the patients who underwent resection, R0 margins were achieved in 37 and R1 margins were obtained in the remaining 22. There were no R2 resections in this series. Lobar resection was performed in 49 (83.1%) of the resected patients. Overall morbidity and 30-day mortality in the resected patients were 39.0% and 5.1%, respectively.

Resection and operative margins

Univariate analysis revealed era (first vs. second), the use of PTC, positive brushings, node status and perineural invasion to be significantly associated with resectability (Table 2). There was a trend towards a higher resection rate in patients undergoing preoperative PVE ($P = 0.060$). Multivariate analysis revealed only nodal invasion to be an independent predictor of resectability [odds ratio (OR) = 0.010, 95% confidence interval (CI) < 0.001–0.226; $P = 0.004$]. In patients who underwent resection, CA19-9 levels, era, lobar resection, perineural invasion and lymphatic invasion were significantly associated with the achievement of negative margins (Table 3). Multivariate analysis revealed only era of resection (first vs. second) to be an independent predictor of R0 resection (OR = 0.016, 95% CI < 0.001–0.462; $P = 0.016$).

Survival

Rates of 1-, 3- and 5-year survival in the first 55 patients were 25.5%, 10.9% and 7.3%, respectively. In the most recent 55 patients, 1-, 3- and 5-year survival significantly increased to 56.3%, 36.5% and 33.7%, respectively ($P = 0.001$) (Table 4).

Table 2 Univariate analysis of factors affecting resection

	Resection group (*n* = 59)	Exploration group (*n* = 51)	*P*-value
Age, years, median (range)	66 (21–88)	62 (32–82)	0.259
Bilirubin, mg/dl, median (range)	8.2 (0.2–35.0)	4.0 (0.4–35.1)	0.235
ALP, IU/l, median (range)	418 (96–3 037)	544 (1–2 750)	0.140
CA19-9, median (range)	214 (5–45 000)	305 (11–30 484)	0.295
Sex, *n* (%)			
Male	34 (52.3%)	31 (47.7%)	
Female	25 (55.6%)	20 (44.4%)	0.693
Race, *n* (%)			
White	54 (54.0%)	46 (46.0%)	
African-American	5 (62.5%)	3 (37.5%)	
Asian	0	1 (100.0%)	
Hispanic	0	1 (100.0%)	0.524
Pain, *n* (%)	11 (45.8%)	13 (54.2%)	0.489
Weight loss, *n* (%)	33 (57.9%)	24 (42.1%)	0.444
Jaundice, *n* (%)	49 (53.9%)	42 (46.2%)	1.00
CT mass, *n* (%)	24 (50.0%)	24 (50.0%)	0.557
Era, *n* (%)			
First era	20 (36.4%)	35 (63.6%)	
Second era	39 (70.9%)	16 (29.1%)	**0.001**
PTC, *n* (%)	37 (67.3%)	18 (32.7%)	**0.007**
PVE, *n* (%)	5 (100.0%)	0	0.060
PSC, *n* (%)	5 (55.6%)	4 (44.4%)	1.00
Cirrhosis, *n* (%)	5 (71.4%)	2 (28.5%)	0.447
Nodal invasion, *n* (%)	9 (15.3%)	50 (84.8%)	**<0.001**
Brushings positive, *n* (%)	26 (66.7%)	13 (33.3%)	**0.047**
Perineural invasion, *n* (%)	11 (18.6%)	48 (81.4%)	**<0.001**

ALP, alkaline phosphatase; CT, computed tomography; PSC, primary sclerosing cholangitis; PTC, percutaneous transhepatic cholangiography; PVE, portal vein embolization.
P-values refer to the difference between the resection and exploration groups. Values in bold are significant at <0.05.

Patients who underwent resection had significantly higher median survival (22.5 months vs. 4.0 months; $P < 0.001$) than those who did not (Fig. 1). The ability to achieve negative margins increased median survival from 4.4 months to 88.2 months ($P < 0.001$) (Fig. 2). Resection to positive (R1) margins significantly increased median survival over exploration alone (16.3 months vs. 4.0 months; $P < 0.001$) (Fig. 3). Perineural invasion (median survival: 4.3 months vs. 23.5 months; $P < 0.001$) and positive lymph nodes (median survival: 4.0 months vs. 32.4 months; $P < 0.001$) were associated with significantly decreased survival. Multivariate analysis of the variables significant on univariate analysis revealed margin status and resection vs. exploration to be independent predictors of survival (Table 5).

Discussion

Historically, hilar cholangiocarcinoma has been considered as a uniformly lethal disease in which expectations for 5-year survival are low. However, as our ability to safely perform hepatic resection has improved, so has the outlook for selected patients with hilar cholangiocarcinoma. Hepatic resection has now become a widely accepted component of surgical therapy and its increased adoption is likely to represent the major driver for the improved rates of resectability seen in this current series.

Our current analysis demonstrated that a survival advantage is associated with resection (vs. no resection) and negative margin status. Our data also show the superiority of resection with R1 margins to exploration alone in terms of survival. Multiple studies have confirmed the value of surgical resection. In this setting, 5-year survival after resection of hilar cholangiocarcinoma has been reported to range from 4% to 37%.[10–15, 17–25] Recognition of the importance of concomitant hepatic resection is probably a key factor in the improved rates of resectability apparent in the more recent era of this current series. Lobar resection was performed in only 27.3% of surgically evaluated patients in the first era of this

Table 3 Univariate analysis of factors affecting the ability to achieve margin-negative resection

	R1	R0	*P*-value
Age, years, median (range)	63 (21–88)	64 (27–88)	0.435
Bilirubin, mg/dl, median (range)	5.7 (0.4–35.1)	7.4 (0.2–30.0)	0.483
ALP, IU/l, median (range)	530 (1–3 037)	418 (96–745)	0.105
CA19-9, median (range)	397.5 (11–45 000)	128.2 (5–2 459)	**0.023**
Sex, *n* (%)			
Male	14 (41.2%)	20 (58.8%)	
Female	8 (32.0%)	17 (68.0%)	0.589
Race, *n* (%)			
White	22 (40.7%)	32 (59.3%)	
African-American	0	5 (100.0%)	0.146
Pain, *n* (%)	2 (18.2%)	9 (81.8%)	0.184
Weight loss, *n* (%)	11 (33.3%)	22 (66.7%)	0.590
Jaundice, *n* (%)	19 (38.8%)	30 (61.2%)	0.729
CT mass, *n* (%)	8 (33.3%)	16 (66.7%)	0.584
Brushings positive, *n* (%)	9 (64.6%)	17 (65.4%)	0.598
Era, *n* (%)			
First era	14 (70.0%)	6 (30.0%)	
Second era	8 (20.5%)	31 (79.5%)	**<0.001**
PTC, *n* (%)	14 (37.8%)	23 (62.2%)	1.00
PVE, *n* (%)	0	5 (100.0%)	0.146
PSC, *n* (%)	2 (40.0%)	3 (60.0)	1.00
Cirrhosis, *n* (%)	2 (40.0%)	3 (60.0%)	1.00
Nodal invasion, *n* (%)	7 (77.8%)	2 (22.2%)	**0.010**
Perineural invasion, *n* (%)	8 (72.7%)	3 (27.3%)	**0.040**
Lobar resection, *n* (%)	14 (29.2%)	34 (70.8%)	**0.013**

ALP, alkaline phosphatase; CT, computed tomography; PSC, primary sclerosing cholangitis; PTC, percutaneous transhepatic cholangiography; PVE, portal vein embolization.
P-values refer to comparison between patients with R1 and R0 resection. Values in bold are significant at <0.05.

Table 4 Survival rates over 1, 3 and 5 years and median survival

	Survival				*P*-value
	1-year	3-year	5-year	Median, months	
All patients	41.7%	23.1%	17.7%	8.0	
First-era group	25.5%	10.9%	7.3%	5.4	
Second-era group	56.3%	36.5%	33.7%	18.8	0.001

P-values refer to the comparison between Era 1 and Era 2 and are significant at <0.05.

study. In the second era, lobar resection was performed in 61.8% of patients. Ability and willingness to extend the field of resection to include concurrent hepatic lobectomy are probably the major reasons why resectability in this series increased from 36.4% in the first-era group to 70.9% in the second-era group.

Despite current acceptance that combined biliary hepatic resection provides improved survival over isolated ductal resection, several controversies remain. These refer to the concept of inadequate residual hepatic reserve, and the extent of resection required to provide negative margins. The most controversial issue has concerned the extent of resection required to obtain tumour-free surgical margins. Several authors have described portal vein resection with reconstruction.[38–41] Hemming *et al.*[38] and Neuhaus *et al.*[22] appear to be the most vocal advocates for portal vein resection. En bloc vascular resection avoids the dissection of tumour-bearing planes, which gives this technique a theoretical advantage. Our group has also selectively utilized the technique of portal vein resection to achieve negative margins. Several groups have demonstrated success using these techniques without an increase in associated morbidity or mortality.[38–40]

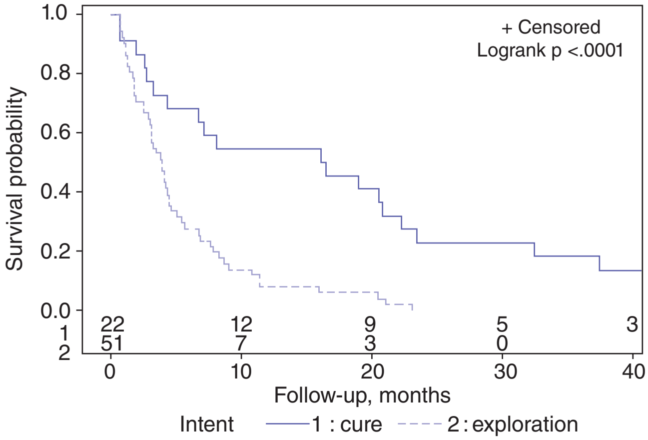

Figure 1 Comparison of survival in patients undergoing surgery with curative intent (resection performed) (—) vs. those undergoing exploration alone (--), showing product-limit survival estimates and number of subjects at risk (log-rank test, $P < 0.0001$)

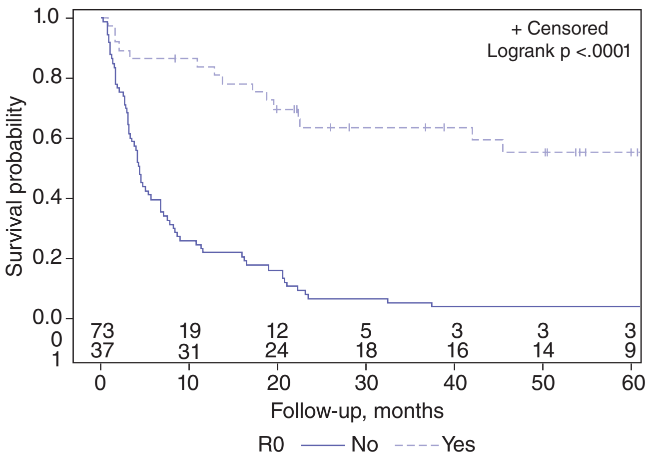

Figure 2 Comparison of survival in patients undergoing margin-negative resection (—) vs. margin-positive resection or exploration alone (--), showing product-limit survival estimates and number of subjects at risk (log-rank test, $P < 0.0001$)

Significant emphasis has been placed on the risk for liver failure associated with an inadequate liver remnant post-resection. This becomes even more significant when the cholangiocarcinoma is associated with primary sclerosing cholangitis with fibrosis or cirrhosis. To avoid inadequate reserve and the risk of liver insufficiency, our group advocates ensuring a calculated remnant based on a preoperative triphasic CT scan and a preoperative liver biopsy to evaluate the hepatic substance for any evidence of fibrosis or cirrhosis. Our current threshold for the consideration of PVE is a predicted future liver remnant of <1000 ml. This figure is based on the transplant experience of the senior author, which implies that 1000 ml is considered to represent the minimal graft volume able to provide sufficient hepatic function. However, this number is only a rough approximation and the decision on what constitutes adequate hepatic parenchyma must be tailored to each patient based on his or her level of hepatic functioning. We also advocate the use of sealant glues over coil embolization in response to concerns over stapler misfire. Imperative to adequate embolization is the understanding of segment IV collateral flow, and the need for selective embolization of this segment to provide adequate contralateral growth. An adequate period of observation, generally of 4–6 weeks, is also required to allow the fullest extent of hepatic hypertrophy.[34–36] The adoption of PVE is likely to represent another important reason for the improved rate of resectability seen in the second-era patient group in this series. Five patients in the second-era group underwent PVE and four of them went on to receive bile duct excision with concurrent lobectomy and hepaticojejunostomy. In the first era of our study period, these patients would not have been deemed surgical candidates based on inadequate future liver remnant. In the future, PVE is certain to play an increasingly important role in the preoperative preparation of patients with Klatskin's tumour.

The final controversy refers to preoperative biliary instrumentation. Several studies have cautioned that the use of preoperative biliary drainage is associated with an increase in the incidence of

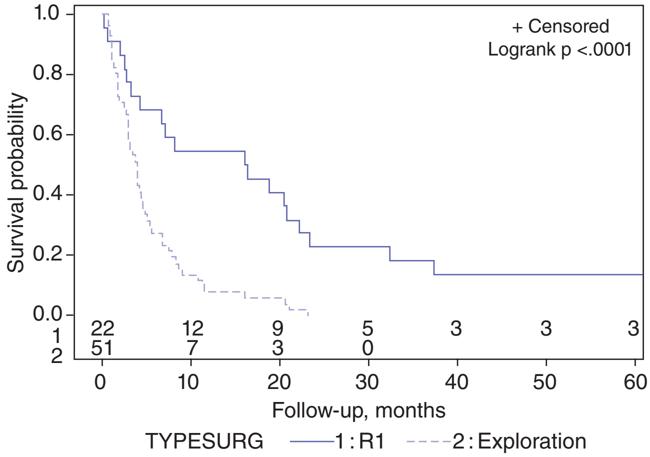

Figure 3 Comparison of survival in patients undergoing R1 resection (—) vs. those undergoing exploration alone (--), showing product-limit survival estimates and number of subjects at risk (log-rank test, $P < 0.0001$)

Table 5 Multivariate Cox proportional hazards analysis of survival

	HR	95% CI	*P*-value
Era (first vs. second)	0.971	0.592–1.592	0.907
Exploration vs. resection	5.075	1.965–13.106	**0.001**
Residual disease after operation	4.124	1.706–9.968	**0.002**
Nodal invasion	1.353	0.215–8.504	0.747
Perineural invasion	1.036	0.179–5.985	0.969

HR, hazard ratio; 95% CI, 95% confidence interval.
P-values in bold are significant at <0.05.

postoperative infection, whereas other reports have indicated improvement in the post-resection liver remnant.[33,37,41,42] Our group advocates the drainage of all three sectors of the liver to decrease serum bilirubin to <10 mg/dl to improve the function of the remnant liver. Early in the series, it was our policy to continue biliary drainage for 6–8 weeks. In more recent patients, we have limited the period of drainage to 1–2 weeks preoperatively. In regard to a technical aspect, stenting also provides a clear plane for dissection and leads to localized fibrosis in the stented biliary radicle. In the present series, stenting represents another factor contributing to the higher resection rates achieved in the second-era patient group. Furthermore, fibrosis of the duct provides better purchase for a subsequent biliary enteric anastamosis.

Renewed attempts at liver transplantation in hilar cholangiocarcinoma have been met with newfound enthusiasm.[43–45] All transplantation protocols are based on either pretransplant chemoradiation therapy or chemophotodynamic therapy. Unfortunately, although numerous patients are screened, only a minority are actually eligible for transplantation. Despite the role of chemotherapy in the neoadjuvant protocol for transplantation, no solid clinical evidence exists for the postoperative administration of chemotherapy in patients undergoing resection for hilar cholangiocarcinoma. Some series have demonstrated modest improvements in survival,[46,47] but this benefit has never been demonstrated clearly in a large prospective trial.

Conclusions

Over the last two decades, the treatment of hilar cholangiocarcinoma has continued to rest firmly on the same cornerstone: resection to negative margins of the biliary tree and hepatic parenchyma. Clear benefit has been observed with the use of an aggressive approach to surgical resection, including concomitant hepatectomy. More uncertain is the use of portal vein resection or pancreatoduodenectomy to achieve tumour-free margins. Advances in interventional radiology, and in percutaneous transhepatic biliary drainage, PVE, anaesthesia and critical care techniques have made the achievement of a higher percentage of R0 resections feasible. However, even when negative margins cannot be achieved, there is still a survival benefit to patients who undergo surgical resection of all gross disease. Despite the renewed hope that other modalities such as transplantation and adjuvant chemoradiotherapy or chemophotodynamic therapy will prove feasible, aggressive resection remains the principal treatment for hilar cholangiocarcinoma. The major limitations of this study refer to its retrospective nature and the fact that it was confined to patients who had been referred for surgical evaluation. The number of patients who are not referred for surgery is substantial and probably constitutes the majority of patients with hilar cholangiocarcinoma. Including these patients would provide a better estimate of the true resectability rate. Furthermore, it is possible that changes in referral patterns may play a role in the increased rate of resectability seen in the more recent era of the study.

Conflicts of interest

None declared.

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