LO 1
RESECTION OF LARGER HEPATOCELLULAR ADENOMAS: WHEN IS IT JUSTIFIED?
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Objective: Hepatocellular adenoma (HCA) is a benign liver tumor for which resection may be indicated if the lesion size is >5 cm six months after withdrawal of oral contraceptives. The aim of this study was to evaluate whether this interval is sufficient to expect regression to ≤5 cm in large HCA and to assess the differences between conservatively treated patients and patients who underwent surgical treatment for HCA >5 cm.

Methods: In this retrospective cohort study we included all subsequent patients with HCA >5 cm diagnosed between 1999–2015 with a follow-up time of at least six months.

Results: We included 194 patients, 2 male and 192 female. In the conservatively treated group (n = 86) we found significantly higher BMI (p = .029), smaller baseline HCA-diameter (p < .001), more centrally located HCA (p < .001) and multiple lesions (p < .001) compared to the treatment group (n = 108). In the conservatively treated group 61 HCA (71%) showed regression to ≤5 cm after a median time of 85 weeks (95%-CI 52–110). Larger HCA take longer to regress to ≤5 cm (p = .001), no differences for time to regression were found between HCA-subtypes. No complications were documented during follow-up.

Conclusion: This study suggests that a six-month cut-off point for consideration of resection in HCA >5 cm may lead to overtreatment. We recommend to prolong the cut-off point in females with typical, non-β-catenin mutated HCA to at least twelve months irrespective of baseline diameter. For HCA >7 cm it might be justifiable to wait up to 24 months assuming that the risk of complications does not increase.

Medical records were reviewed for patient/lesion characteristics, management and complications.
EVALUATING THE AMERICAN COLLEGE OF SURGEONS NATIONAL SURGICAL IMPROVEMENT PROJECT RISK CALCULATOR IN EXTRAHEPATIC BILIARY MALIGNANCY: RESULTS FROM THE U.S. EXTRAHEPATIC BILIARY MALIGNANCY CONSORTIUM


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Objective: To assess the accuracy of the ACS NSQIP calculator for estimating risk after operation for gallbladder cancer and extrahepatic cholangiocarcinoma.

Methods: Adult patients with gallbladder cancer, distal or hilar cholangiocarcinoma who underwent curative-intent, complete resection January, 2000—December, 2014 were included. The ability of the NSQIP calculator to accurately predict a particular outcome was assessed using the c-statistic (0.7 or above score for reasonable models) and Brier score (zero score for perfect models).

Results: 854 adult patients were included. The most commonly performed procedures included right or left hepatic lobectomy (254, 29.7%), pancreaticoduodenectomy (132, 15.5%) and trisegmentectomy (118, 13.8%). 185 patients experienced surgical site infection (SSI) (21.7%, median predicted risk of 9.6%, range: 1.9—36.6%). There was 2.1% mortality (median predicted risk of 0.5%, range: 0—19.4%). There were 57 (6.7%) reoperations (median predicted risk of 3.3%, range: 0.9—13.2%). 169 (19.7%) patients were readmitted (median predicted risk of 9.1%, range: 2.6—32.2%). The median length of stay in the cohort was 8 days (Range: 0—119 days) and the median predicted length of stay was 6.5 days (Range: 2.5—25.5 days). The c-statistics for SSI, mortality, reoperation and readmission were 0.64, 0.74, 0.68 and 0.57 and Brier scores were 0.17, 0.02, 0.06 and 0.16 respectively (FIGURE).

Conclusion: The ACS NSQIP Risk Calculator estimates the risk of mortality reasonably well for patients with gallbladder and extrahepatic biliary malignancy but generally underestimates risk of several other postoperative complications. Future modifications of the calculator for some patient populations are needed before widespread use of the tool can be encouraged.

TRENDS IN THE MANAGEMENT OF RESECTABLE HEPATOCELLULAR CARCINOMA (HCC): IMPROVED OUTCOMES WITH AGGRESSIVE SURGICAL INTERVENTION

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Objective: While overall cancer incidence and mortality have decreased over the last decade, liver cancer cases have increased sharply. We set out to evaluate the utility of surgery for resectable HCCs in this setting.

Methods: We analyzed the National Cancer Database (NCDB), selecting all patients with a histological diagnosis of HCC with an isolated lesion (<5 cm).
Results: A total of 10,055 patients were included in this study. In the patients with a single lesion ≤3 cm, 51.2% received no surgery, 21.6% had radiofrequency ablation (RFA), and 9.1% had surgical resection. In the group with tumors >3 cm, 64.1% received no surgery, 12.7% had RFA, and 14% had surgical resection. Patients more likely resected were: younger (p < 0.001, HR 1.166), had tumors ≤3 cm (p < 0.001, HR 1.442), MELD score <15 (p < 0.001, HR 2.166), no vascular invasion (p < 0.001, HR 3.291), and none-moderate fibrosis (p < 0.001, HR 6.639). Insurance status and type of cancer facility were not significant. The 3-year survival for patients with tumors ≤3 cm with no surgery, RFA, and surgical resection were 35%, 49%, and 72%, respectively, versus 23%, 35%, and 56% in those with tumors >3 cm (p < 0.001). Multivariable regression demonstrated that patients that underwent surgical resection with tumors ≤3 cm (p < 0.001, HR 1.719), no vascular invasion (p < 0.046, HR 1.452), and none-moderate fibrosis score (p < 0.001, HR 3.032) had improved survival.

Conclusion: Surgical resection may be underutilized in the United States for resectable hepatocellular carcinoma. Patients with tumors ≤3 cm with no vascular invasion and low fibrosis scores should be strongly considered for hepatectomy.

LO 4

NEOADJUVANT THERAPY AND SURGICAL RESECTION OF EARLY-STAGE INTRAHEPATIC CHOLANGIOCARCINOMA: INSIGHTS FROM THE NATIONAL CANCER DATABASE

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Objective: Neoadjuvant treatment for potentially resectable hepatobiliary malignancies has become increasingly common. Intrahepatic cholangiocarcinoma has poor survival and its low incidence makes it difficult to study prospectively. Therefore, retrospective analysis was performed to determine if neoadjuvant therapy offers a survival advantage in the treatment of resected intrahepatic cholangiocarcinoma.

Methods: Patients with AJCC 7th edition clinical T1 or T2, N0, M0 intrahepatic cholangiocarcinoma undergoing resection within 1 year of diagnosis were identified in the National Cancer Database, 2004–2012. The effect of neoadjuvant therapy, patient comorbidities, and pathologic staging on overall survival was assessed using Kaplan–Meier analysis and Cox proportional hazards regression modeling.

Results: 2878 patients met eligibility criteria. Median follow-up was 25.3 months, median survival was 35.1 months, and 5-year overall survival (OS) was 36%. 248 patients (9%) received neoadjuvant chemotherapy or radiation therapy or both. Receipt of neoadjuvant therapy was associated with a decreased rate of upstaging on pathology (p = 0.30, OR 0.65 [95% CI 0.44 0.96]) and with improved 5-year OS (44% versus 36%; p = 0.011, HR 0.78 [95% CI 0.65 0.95]) (Figure 1). However, on multivariate analysis, neoadjuvant therapy was not a significant predictor of OS (p = 0.19). Improved survival was associated with female gender, negative pathologic N and M status, and decreasing age, comorbidities, and tumor size.

Conclusion: In early stage resected intrahepatic cholangiocarcinoma, neoadjuvant therapy is independently associated with improved survival. However, patient-specific and tumor-specific variables are more strongly associated with survival after resection. Prospective evaluation of neoadjuvant therapy in early-stage intrahepatic cholangiocarcinoma should be considered.
LO 5

**CLINICAL IMPLICATION OF CONVERSION HEPATECTOMY FOR INITIALLY UNRESECTABLE COLORECTAL LIVER METASTASES**

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**Objective:** Clinical implication of conversion hepatectomy for initially unresectable (IUR) colorectal liver metastases (CLM) remains unclear. The aim of this study was to assess feasibility and survival outcomes of conversion hepatectomy for IUR CLM in comparison with those after hepatectomy for resectable CLM.

**Methods:** Database of 482 patients undergoing curative hepatectomy for CLM between 2005 and 2013 was reviewed. Resectability was categorized according to the number and size of CLM, and technical eligibility for resection. Conversion hepatectomy was performed for 68 patients with IUR CLM (14%) after preoperative chemotherapy. Upfront surgery was performed in 257 patients who had Resectable CLM (n ≤ 3 and <5 cm). The remaining 157 patients had borderline Resectable (BR) CLM (n > 3 or ≥5 cm), and neoadjuvant chemotherapy was performed in 68 patients with BR CLM. Short-term and long-term outcomes were compared among patients who had Resectable, BR, and IUR CLM.

**Results:** In patients with IUR CLM, major hepatectomy (≥3 segments) was most frequently performed (37%, Resectable: 7%, BR: 27%, p < .0001), and more operation time (median: 384 min., p < .0001) and blood loss (765 ml, p < .0001) were observed than in those of Resectable (243 min., 220 ml) and BR CLM (354 min., 500 ml). The 5-year (37.4%) overall survival rates of patients with IUR CLM were worse than those of patients with Resectable (66.3%, p < .0001), BR with chemotherapy (76.9%, p = 0.0001), and BR CLM without chemotherapy (48.9%, p = 0.0345).

**Conclusion:** Conversion hepatectomy for IUR CLM was technically demanding. However, conversion hepatectomy can improve prognosis, offering a 37% of 5-year overall survival rate.

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LO 6

**EXTRAHEPATIC CHOLANGIOCARCINOMA: OUTCOMES STRATIFIED BY TYPE OF OPERATION REQUIRED**


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**Objective:** Cholangiocarcinoma can develop anywhere along the biliary tree. Differences in perioperative morbidity and oncologic outcomes based on the type of operation performed for extrahepatic cholangiocarcinoma (EHCC) have not been well characterized.

**Methods:** Patients who underwent curative resection for EHCC (excluding gallbladder cancer) were identified using the U.S. Extrahepatic Biliary Malignancy Consortium database. Patients were classified into three categories based on type of operation performed: bile duct resection (BDR) only, pancreaticoduodenectomy (PD), and major hepatectomy (MH). Patient factors, tumor characteristics, morbidity, and survival were evaluated.

**Results:** Of 532 patients with EHCC, 103 underwent BDR only (19%), 226 PD (42%) and 203 MH (38%). BDR, when compared with PD and MH, was associated with lower lymph node harvest (2 vs. 16 vs. 4 nodes, P < 0.001) and higher R1 margins (46% vs. 20% vs. 29%, P < 0.001). Major complications (10% vs. 12% vs. 22%, P = 0.005) and 30-day mortality (1% vs. 6% vs. 11%, P = 0.029) were lower in the BDR group. Among R1 BDR patients, 38% had positive margins at both the proximal and distal bile duct. Disease-specific survival was significantly lower after BDR compared with PD (p = 0.04) or MH (P = 0.03, Figure). On multivariate analysis, lymphovascular invasion (P = 0.023), poor grade (P = 0.02), AJCC stage III/IV (p = 0.01), and R1 margins (P = 0.049), but not the type of operation were all independent predictors of poor survival.

**Conclusion:** Although bile duct resection only is associated with a better safety profile compared with pancreaticoduodenectomy or major hepatectomy for extrahepatic cholangiocarcinoma, it is associated with higher margin positivity and significantly lower nodal harvest, as well as shorter disease-specific survival.
LO 7
PORTAL VEIN EMBOLIZATION WITH STEM CELLS APPLICATION FOR ENLARGEMENT OF FUTURE LIVER REMNANT VOLUME IN PRIMARY NON-RESECTABLE COLORECTAL LIVER METASTASES

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Objective: Insufficient future liver remnant volume (FLRV) is one of the main causes of colorectal liver metastases (CLMs) non-resectability. Portal vein embolization (PVE) alone is not sufficient method for FLRV growth in some patients. Combination of PVE with application of autologous hematopoietic stem cells (aHSC) can be the method for optimization of FLRV growth.

Methods: PVE with application of bone marrow aHSC was used in 23 patients with primary non-resectable CLMs due to insufficient FLRV between 3/2011 and 8/2016. PVE was performed on the site of CLMs and aHSC (from bone marrow) were applied to the contralateral liver lobe in one stage procedure. FLRV growth was examined by computed tomography volumetry each week after procedure. Liver resection was performed as soon as FLRV was ≥30% of healthy liver tissue, resp. >40% of the total liver volume in patients after chemotherapy or with primary liver disease.

Results: Sufficient FLRV developed in all patients in the interval of 2–3 weeks after procedure. R0 hepatectomy was performed in 19 (82.6%), exploratory laparotomy in four patients (3× tumor progression, 1× severe adhesions). One and two years OS was 76.6, resp. 50.3%, DFI 67.2, resp. 32.1% in patients after liver resection. Number of CLMs was only significant factor for DFI (p < 0.04). The growth of CLMs volume was found in 19 (82.6%) of patients (p < 0.003), but it was insignificant for OS or DFI.

Conclusion: PVE with application of aHSC appears to be promising method for stimulation of FLRV growth. Supported by the Research Project P-36.

LO 8
A SINGLE-PLATFORM CYST FLUID ASSAY TO PREDICT IPMN WITH HIGH-MALIGNANT POTENTIAL FOR SURGICAL RESECTION: A MULTI-INSTITUTIONAL INTERNATIONAL REPORT

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Objective: Current standard-of-care technologies are unable to distinguish IPMN at high-risk of malignancy from low-risk lesions. The objective of this study was to create a single-platform assay to identify IPMN that are at high-risk for malignant progression.

Methods: Building on the Verona consensus conference BD-IPMN biomarker study; specific protein, cytokine, mucin, and miRNA cyst fluid targets were identified for creation of a q-PCR based assay. A multi-institutional international IPMN cyst fluid collaborative contributed patient samples to validate this platform.

Cyst fluid gene expression levels were processed to obtain RQ values that were normalized, z-transformed, and utilized in classification and regression analysis by a support vector machine (SVM) training algorithm.

Results: From 59 cyst fluid samples, principal component analysis confirmed no institutional bias/clustering. Sixty percent of eligible samples were randomized to a training set, followed by SVM model optimization with 10-fold cross-validation, and then applied to a test set. The model was repeated 100 times and performance determined by ROC analysis. Machine learning methods classified samples into low-risk (low/moderate dysplasia) or high risk (high-grade dysplasia/invasive cancer). The assay accurately discriminated high from low-risk cysts with a c-statistic (AUC) of 0.83 (figure).

Conclusion: We have identified a single-platform PCR-based assay using multiple targets to predict IPMN with high-malignant potential. The creation of this test may
allow patients with low-risk IPMN to avoid pancreatic surgery, while identifying patients with high-risk lesions so that they may undergo surgery before the development of invasive disease.

Methods: This multinational study included 5,323 PDs performed by 62 surgeons at 17 institutions. Mitigation strategies, including both technical (pancreaticogastrostomy reconstruction; dunking; tissue patches) and technological (intraperitoneal drains; anastomotic stents; prophylactic octreotide; tissue sealants), were evaluated using multivariable regression analysis and propensity score matching.

Results: A total of 522 (9.8%) PDs met high-risk FRS criteria, with an observed CR-POPF rate of 29.1%. Pancreaticogastrostomy, prophylactic octreotide and absence of externalized stents were each associated with an increased rate of CR-POPF (all \( p < 0.001 \)). In a multivariable model accounting for patient, surgeon and institutional characteristics, the use of external stents (internal: OR 2.94, 95% CI 1.29–6.72; none: OR 2.07, 95% CI 1.01–4.29) and the omission of prophylactic octreotide (OR 0.53, 95% CI 0.33–0.85) were independently associated with decreased CR-POPF occurrence. In the propensity score-matched cohort, an “optimal” mitigation strategy (i.e. pancreaticojejunostomy, externalized stent, and no prophylactic octreotide) was associated with a reduced rate of CR-POPF (13.2% vs. 29.3%, \( p = 0.002 \)).

Conclusion: The scenarios identified by the high-risk FRS zone represent challenging anastomoses associated with markedly elevated rates of fistula. Optimal outcomes are obtained using pancreaticojejunostomy and externalized stents, without octreotide.

LO 9
THE CHARACTERIZATION AND OPTIMAL MANAGEMENT OF HIGH-RISK PANCREATIC ANASTOMOSES DURING PANCREATODUODENECTOMY
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Objective: The utility of technical strategies to prevent clinically relevant postoperative pancreatic fistula (CR-POPF) following pancreaticoduodenectomy (PD) may vary by the circumstances of the anastomosis. The Fistula Risk Score (FRS) identifies a distinct high-risk cohort (FRS 7–10) that demonstrates substantially worse clinical outcomes. The value of various fistula mitigation strategies in these particular high-stakes cases has not been previously explored.

Methods: This multinational study included 5,323 PDs performed by 62 surgeons at 17 institutions. Mitigation strategies, including both technical (pancreaticogastrostomy reconstruction; dunking; tissue patches) and technological (intraperitoneal drains; anastomotic stents; prophylactic octreotide; tissue sealants), were evaluated using multivariable regression analysis and propensity score matching.

Results: A total of 522 (9.8%) PDs met high-risk FRS criteria, with an observed CR-POPF rate of 29.1%. Pancreaticogastrostomy, prophylactic octreotide and absence of externalized stents were each associated with an increased rate of CR-POPF (all \( p < 0.001 \)). In a multivariable model accounting for patient, surgeon and institutional characteristics, the use of external stents (internal: OR 2.94, 95% CI 1.29–6.72; none: OR 2.07, 95% CI 1.01–4.29) and the omission of prophylactic octreotide (OR 0.53, 95% CI 0.33–0.85) were independently associated with decreased CR-POPF occurrence. In the propensity score-matched cohort, an “optimal” mitigation strategy (i.e. pancreaticojejunostomy, externalized stent, and no prophylactic octreotide) was associated with a reduced rate of CR-POPF (13.2% vs. 29.3%, \( p = 0.002 \)).

Conclusion: The scenarios identified by the high-risk FRS zone represent challenging anastomoses associated with markedly elevated rates of fistula. Optimal outcomes are obtained using pancreaticojejunostomy and externalized stents, without octreotide.

Figure 1 Optimization of fistula mitigation strategies (A: \( n = 53; B = 113; C: n = 106; D = 167 \)); operatively placed drains were utilized in 98.1%, 100.0%, 74.5% and 100.0% of cases, respectively.
LO 10
PATIENTS WITH GENETIC PANCREATITIS SHOULD HAVE EARLY REFERRAL FOR TOTAL PANCREATECTOMY WITH ISLET AUTOTRANSPLANTATION

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Objective: Total pancreatectomy with islet autotransplantation (TPIAT) is an effective means of pain relief in chronic pancreatitis. Patient selection, including timing of intervention, remains challenging. Genetic etiologies of pancreatitis are increasingly recognized and deserve distinct consideration, including potentially different treatment algorithms

Methods: A prospective TPIAT database is reviewed. Genetic pancreatitis patients are compared to those with other etiologies and genetic patients with prior pancreatic surgery are compared to those without. Quality of life (qol) is assessed by SF-12

Results: 174 patients underwent TPIAT (129 women; age 40). Thirty-eight (22 women; age 30; 15 PRSS1; 15 CFTR; 2 SPINK1; 3 SPINK1/CFTR) had genetic pancreatitis (GP) and 136(107 women, age 43) had other etiologies (NGP). GP had longer disease duration than NGP patients (10.6v7.1 years, p = 0.0010) and had fewer islets harvested (2470v3703 IE/kg, p = 0.02), but had similar rates of insulin independence at 2 years (40%v35%, p = NS). GP patients had better preoperative physical and mental qol scores (35v27, 47v38, p = 0.001) and better postoperative scores at 2 years than NGP (pqol 43v34, mqol 46v41, p < 0.01). Nine GP patients had pancreatic surgery prior to TPIAT (GPPS) and had longer disease duration (17.9 years, p = 0.002) than those without prior surgery (GPNS). GPPS patients trended toward a lower islet yield (1603v2727 IE/kg, p = 0.06) and insulin independence (11v30%, p > 0.05) than GPNS. Their preop qol scores were similar but postop pqol scores were lower (33v44, p = 0.02)

Conclusion: GP patients do well with TPIAT, with superior qol improvements and similar islet function to non-genetic patients. GP patients with prior pancreatic surgery do less well, trending toward lower islet yield and function, and lesser improvements in qol. GP patients may do better with earlier referral for TPIAT.

LO 11
GENOMIC AND TRANSCRIPTOMIC CHARACTERIZATION OF ADVANCED PANCREATIC DUCTAL ADENOCARCINOMA (PDAC) MAY INFORM SYSTEMIC THERAPY

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Objective: Sequencing of retrospective cohorts of resected PDAC have identified prognostic and predictive molecular markers. Feasibility of personalized therapy by application of these markers to patients prospectively has not been shown.

Methods: We previously performed whole genome (WGS) and transcriptome (WTS) sequencing on retrospectively-collected, resected tumours from over 200 patients. Through the prospective UHN/OICR PanCuRx Translational Research Initiative COMPASS trial (NCT02750657), 18G-needle biopsies are taken of metastatic or locally-advanced PDAC that then undergo WGS and WTS within 2 months. Results are discussed at multidisciplinary cancer conferences to study markers of response/failure and select second-line palliative therapies.

Results: In our retrospective cohort, we show that mutational processes cluster PDAC into four subtypes, “Age Related”, “Double-strand break repair (DSBR)”, “Mismatch repair (MMR)” and “Unknown (Signature 8)”. Anti-tumour immunity is enriched in DSBR and MMR groups, correspondingly to high burdens of tumor-specific neoantigens and correlating with increased expression of immune regulatory genes, including CTLA-4 and PD-1, implying a role for immunotherapy in selected patients. Recurrent somatically-altered loci, including ARID1A, CDK4 and CDK6, are also potentially targetable.

Since December 2015, 25 patients prospectively contributed metastatic tumor samples, largely from the liver (88%). DNA and RNA qualities were satisfactory for WGS and WTS in 95% and 88% cases, respectively. Four patients who progressed on first-line therapy were eligible for second-line trials informed by the molecular characterization of their tumours, including two on CDK4/6 inhibitors and two on immunotherapies, with outcomes pending shortly.

Conclusion: Personalized therapy with molecular biomarkers is feasible in PDAC using WGS and WTS of biopsy specimens.

LO 12
ARE BRCA2 GENE MUTATION PATIENTS INAPPROPRIATELY UNDERSCREENED FOR PancreATIC ADENOCARCINOMA?

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Objective: BRCA2 mutations account for the highest proportion of hereditary causes of pancreatic adenocarcinoma with a 3–6-fold increased risk. However, screening is currently recommended only for patients with one first-degree relative or two family members affected with pancreatic adenocarcinoma. We hypothesized that screening all BRCA2 patients would identify a higher rate of pancreatic abnormalities.

Methods: All patients with genetically confirmed BRCA2 mutations at a single academic center were retrospectively reviewed (2005–2015). Pancreatic abnormalities were defined on cross-sectional imaging as pancreatic neoplasm (cystic/solid) or main duct dilation.

Results: Among 117 patients with BRCA2 mutation, 98% were asymptomatic. Only 47 (40%) had abdominal imaging (20 CT and 27 MRI) for review. Ten of those 47 patients (21%) had pancreatic abnormalities (adenocarcinoma (n = 2), IPMN (n = 7), simple cyst (n = 1)). The prevalence
of pancreatic abnormalities and IPMN was higher in BRCA2 patients than in the historical general population (21% vs. 8% and 17% vs. 1%, p = 0.0007 and <0.0001, respectively). No statistical difference was seen in rate of pancreatic abnormalities or IPMN according to family history of pancreatic adenocarcinoma. Furthermore, all pancreatic adenocarcinomas developed in patients without a positive family history.

**Conclusion:** In this series, 4% and 17% of BRCA2 patients developed pancreatic adenocarcinoma and IPMN, respectively, which is higher than previously reported. Under current recommended screening, 60% of BRCA2 patients had incomplete pancreatic assessment. With no influence of family history status, this study suggests all BRCA2 patients should undergo a high-risk screening protocol that will identify a higher rate of precancerous pancreatic neoplasms amenable to curative resection.

**LO 13**

**REDEFINING THE KI-67 INDEX STRATIFICATION FOR LOW-GRADE PANCREATIC NEUROENDOCRINE TUMORS: IMPROVING ITS PROGNOSTIC VALUE FOR RECURRENTENCE OF DISEASE**

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**Objective:** Ki-67 is an established prognostic marker for recurrence after resection of pancreatic neuroendocrine tumors (PanNETs), which groups tumors into 3-categories of low, intermediate, and high grade (<3%, 3–20%, and >20%). Given that most resected PanNETs are <3%, our aim was to further stratify this group to more accurately predict recurrence of disease.

**Methods:** Ki-67 index was re-reviewed and scored by pathologists blinded to all other clinicopathologic variables using tissue microarray blocks made in triplicate for patients who underwent curative-intent resection of non-metastatic PanNETs at a single institution from 2000–2013. Primary outcome was recurrence-free survival (RFS).

**Results:** Of 113 PanNETs resected, 83 had tissue available for analysis. Ki-67 was <3% in 72 (87%), 3–20% in 11 (13%), and >20% in 0 tumors. All tumors were well-differentiated. Considering only <3%, tumors were further stratified by Ki-67 into A: <1% (n=43), B: 1–1.99% (n=23), and C: 2–2.99% (n=6). Compared to group A, groups B and C more frequently had advanced T-stage tumors (T3: 44 and 67% vs 12%; p=0.003) and lymphovascular invasion (50 and 83% vs 23%; p=0.007). Group B and C had a similar 1- and 3-yr RFS, both less than group A (Figure 1A). After combining groups B and C, a Ki-67 of 1–2.99% was associated with decreased RFS compared to group A (<1%) (Figure 1B). This persisted on multivariable analysis (HR: 10.3; 95% CI: 1.3–83.2; p=0.03), controlling for tumor size >2 cm, margin-positivity, LN-involvement, and advanced T-stage.

**Conclusion:** PanNETs with a Ki-67 of 1–2.99% have distinct biologic behavior and earlier recurrence of disease compared to those <1%. This new stratification scheme, if externally validated, should be incorporated in future grading systems.

**LO 14**

**PREDICTORS OF DELAYED GASTRIC EMPTYING AFTER ROBOTIC PANCREATEODUODENECTOMY: ANALYSIS OF INTRAOPERATIVE TECHNIQUES USING VIDEO REVIEW**

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**Objective:** Delayed gastric emptying (DGE) remains a major driver of prolonged length of stay and morbidity following the pancreatoduodenectomy. The objective of this study was to evaluate whether technical factors observed during video review of DGE during robotic pancreatoduodenectomy (RPD) could add to predictive models of DGE.

**Methods:** Two blinded surgeons analyzed RPD videos with 90-day postoperative clinical data. DGE was classified according to ISGPS criteria. Clinical and technical variables were analyzed using multivariate analysis (MVA). Specific variables reviewed were: 1) type of anastomosis 2) angle of efferent limb 3) OSATS score of performing surgeon, 4) length of time to complete anastomosis, and 5) if performed by trainee.

**Results:** Video was available for 172 RPD, 56% percent of all performed during time period. DGE was observed in 38 (21.1%): A = 15 (40%), B = 12 (32%), and C = 11 (29%). Clinical variables (prior to inclusion of technical variables)
that predicted DGE on MVA were age, duct size and non-pancreatic adenocarcinoma malignancies (p = 0.0003; R^2 = 0.112). As a group, trainees took longer to complete the anastomosis than attendings (p = 0.029). On MVA, the best model of independent predictors of DGE included (p = 0.0002; R^2 = 0.1651): advanced age, small pancreatic duct, short [1st Interquartile Range] gastrotomy (<4.5 cm) length, stapled (compared to sutured) anastomosis, extreme efferent GJ angle from midline (>30°; middle figure best), and performance of anastomosis by trainee.

**Conclusion:** Technical components of the gastrojejunostomy added to predictive models of DGE. This study establishes the framework for innovative prospective quality improvement projects targeting surgical micro-techniques available only through review of video databases.

LO 15
MONITORING CHANGES IN MYELOID-DERIVED SUPPRESSOR CELLS POST-EMBOLIZATION TO IDENTIFY HCC PATIENTS WITH HIGH RECURRENCE RISK FOLLOWING LIVER TRANSPLANTATION
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**Objective:** Identify high recurrence risk HCC patients by tracking MDSC levels following trans-arterial chemo-embolization (TACE).

**Methods:** Enrollment included 22 HCC patients undergoing TACE (100–300 micron particles with 100 mg doxorubicin). Blood was collected pre-procedure with follow-up collection <30 days following procedure. PBMCs were analyzed by flow cytometry for MDSCs (CD45+CD33+HLA-DR-LO/NEG and subdivided based on CD14, CD15, or CD16 expression).

**Results:** HCC patients included 8 TACE-naïve and 12 previously embolized, staged T2–T3a with MELD of 10 ± 3. MDSC phenotyping revealed dramatic baseline expansion an HCC patient subset mixed TACE history. Expansion (i.) in TACE-naïve patients was associated with primary tumor diameter >4 cm and (ii.) new or growing lesions in previously embolized patients. MDSC subtyping revealed a distinct patient subset with elevated levels of CD16+CD14NEG MDSC elevation (>20% of MDSCs). CD16+CD14NEG MDSCs were more prominent in TACE-naïve patients whose primary tumor was >4 cm, with 2 of 6 TACE-naïve patients showing post-procedure elevations in both total MDSCs and CD16+CD14NEG MDSCs at 30 day follow-up. In the previously embolized cohort, 4 of 12 patients had >8% persistent CD16+CD14NEG MDSC elevation during admission for current TACE procedure.

**Conclusion:** We observed CD16+CD14NEG MDSC expansion in TACE naïve patients and persistent elevation in a subset of previously embolized patients, which could potentially identify an HCC patient subset at high recurrence risk post-LTx. In this patient cohort, we are collecting circulating tumor DNA and circulating tumor cells post-TACE for correlation with PMN-MDSC status. Our goal is to develop of blood biomarker panel to identify high recurrence risk HCC patients.
COST OF ACHIEVING EQUIVALENT OUTCOMES IN SICKER PATIENTS AFTER LIVER TRANSPLANT

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University of Cincinnati, Cincinnati, OH, USA

Objective: Determinants of cost after liver transplant (OLT) are unknown. We aimed to characterize the variability in cost after uncomplicated OLT and determine impact on graft and overall survival.

Methods: Using a linkage between the University Health Systems Consortium and Scientific Registry of Transplant Recipients databases, we identified 12,245 patients who underwent OLT between 2011 and 2014. Patients who met criteria for uncomplicated OLT, defined as length of stay (LOS) < 14 days with discharge to home, were selected (n = 5,763). Patients were grouped into tertiles (low, medium, high) according to cost of perioperative stay.

Results: Patients undergoing uncomplicated OLT were of similar age, gender, insurance status, and etiology of liver disease across all three groups. High cost patients were more likely on hemodialysis preoperatively, had higher severity of illness, and had higher MELD score (all \( p < 0.01 \)). High cost patients required increased utilization of resources including lab tests, blood transfusions, and opioids (all \( p < 0.01 \)). Despite higher burden of disease necessitating increased resource utilization, high cost OLT patients with an uncomplicated perioperative course were shown to have identical 2-year graft and overall survival compared to lower cost patients (\( p = 0.66 \) and \( p = 0.94 \), respectively).

Conclusion: Improved perioperative outcomes in OLT patients with higher severity of illness and disease burden will require increased cost and resource utilization; however doing so provides these patients with equivalent long term survival. These findings support a recipient risk-based bundled reimbursement for liver transplantation.
LO 17
FACTORS PREDICTIVE OF OUTCOME BEFORE AND AFTER TRANSPLANTATION FOR FULMINANT HEPATIC FAILURE
Hospital das Clinicas from University of Sao Paulo, Sao Paulo, Brazil

Objective: We aimed to evaluate prognostic factors for patients with fulminant hepatic failure (FHF) referred to liver transplantation (LT).

Methods: We retrospectively studied 156 adult patients (82 female, mean age 37.73 ± 15.84 y) with FHF referred to urgent transplantation at our Institution. Etiologies were virus in 15% of cases, drug-induced in 41%, autoimmune in 13%, cryptogenic in 27% and other in 4%. LT was indicated according to O’Grady criteria. Analysis of outcome after LT included deceased donor data.

Results: Mortality rate before LT was 45%. At prioritization, non-survivors showed higher grade of encephalopathy (82.9% × 61.7%), creatinine (2.37 ± 2.02 × 1.51 ± 1.45 mg/dL) lactate (60.0 ± 42.9 × 39.3 ± 28.3 mg/dL), MELD (40.0 ± 12.9 × 33.7 ± 11.9), rate of kidney failure (80.0% × 46.1%), dialysis (37.5% × 18.0%) and cryptogenic etiology (41.7% × 19.6%) and less autoimmune hepatitis (4.17% × 17.8%) compared to survivors. Multiple logistic regression identified renal failure and INR as independent prognostic factors for death before LT. Cox model evaluating 30-day outcome after LT of 107 patients identified patients grade of encephalopathy, jaundice-encephalopathy interval, lactate, arterial pH and renal failure, and donor BMI, creatinine, sodium, glucose, AST, pH and DRI as possible factors of worse prognosis. Multivariate cox regression identified receptor lactate >41 mg/dL and arterial pH <7.368, and donor BMI >26.2 kg/m², creatinine >0.68 mg/dL, glucose >42 mg/dL and AST >24 UI/L as independent indicators of mortality after LT (Figure).

Conclusion: At prioritization to LT, FHF patients with a poor liver function condition associated to prolonged INR and renal impairment have higher chance of death before transplantation. On the other hand, survival after LT is associated to patient lactate levels and pH at prioritization and to donor obesity, levels of creatinine, glucose and AST.

LO 18
EVALUATION OF THE ABILITY OF SCORING SYSTEMS IN PREDICTING LIVER GRAFT UTILIZATION
J. Tang and A. Zarrinpar
University of California, Los Angeles, Los Angeles, CA, USA

Objective: The quantitative evaluation of liver graft quality is an understudied problem in transplantation. The gold standard remains physical evaluation by transplant surgeons. We evaluated four prognostic scoring systems for their ability to predict graft utilization and 30-day survival.

Methods: To compare D-MELD, SOFT, BAR and DRI scores in predicting graft quality, we assessed their value in predicting graft utilization (donor liver procured and transplanted versus all other consented donors) and 30-day graft failure for all transplanted livers. Data were obtained from SRTR encompassing all UNOS deceased donors from 10/02/1987 date to 6/30/2015. We excluded DCD donors and those younger than 18.

Results: All four scores were able to predict 30-day graft failure with statistical significance, though SOFT had the lowest AIC. Only SOFT and DRI can predict graft utilization using donor information alone (P = 0.0008 and P = 2 × 10−10, respectively), with the AIC of DRI marginally better (9014 v 8986). More than 11% of transplanted grafts had DRI >2.0. Using regional sharing and an eight-hour CIT half of the discarded grafts had a score less 1.68 and a quarter had a score less than 1.4.

Conclusion: While these scores provide useful information to predict graft and recipient survival, only DRI is geared towards predicting graft quality. However, even the DRI cannot provide adequately discriminating information on liver grafts to make decisions on utilization. To maximize organ utilization while minimizing recipient risk, what is needed is a standardized, quantitative measure of liver function performed before procurement.
NOVEL GUIDELINES FOR SAFE AND EFFECTIVE SLEEVE GASTRECTOMY IN CIRRHTIC PATIENTS AWAITING TRANSPLANT

A. Jung, V. Dhar, Y. Kim, S. Shah, D. Schauer, E. Smith and T. Diwan
University of Cincinnati, Cincinnati, OH, USA

Objective: With non-alcoholic steatohepatitis (NASH) projected to become the leading indication for liver transplantation in the next decade, we pursued strategies to proactively treat obese cirrhotic patients awaiting transplant.

Methods: Data was collected prospectively on 9 patients with liver disease who underwent laparoscopic sleeve gastrectomy (LSG) by a single surgeon. A multidisciplinary team implemented criteria for patient selection: (1) Model for End-stage Liver Disease (MELD) score <15, (2) no evidence of portal hypertension (3) no ascites (4) platelet count >50,000 U/µL. Patient demographics, comorbidities, body mass index (BMI), MELD scores, and laboratory values were analyzed retrospectively.

Results: Etiologies of liver disease were NASH (n = 7), primary sclerosing cholangitis (n = 1), and autoimmune hepatitis (n = 1). Median age was 46 years (range 43–59 years). Median pre-operative MELD score was 7 (range 6–14). Mean pre-operative BMI was 44.4 ± 7.3 kg/m². Follow-up after LSG was 141 ± 126 days with post-operative BMI average of 36.9 ± 7.8 kg/m². Mean percentage of excess weight loss was 35.3 ± 23.6%. There were no complications or acute liver decompensation during follow-up. No clinically significant differences were seen between pre- and post-operative liver function tests. Of the three patients who

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age</th>
<th>Pre-op MELD</th>
<th>Pre-op BMI</th>
<th>Post-op BMI</th>
<th>%EWL</th>
<th>Length of follow-up (days)</th>
<th>Length of stay (days)</th>
<th>Pre-op anti-hypertensive medications</th>
<th>Post-op anti-hypertension medications</th>
<th>Pre-op insulin</th>
<th>Post-op insulin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient 1</td>
<td>45</td>
<td>8</td>
<td>42.79</td>
<td>35.04</td>
<td>31.13</td>
<td>137</td>
<td>1</td>
<td>0</td>
<td>0</td>
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<td>Patient 2</td>
<td>44</td>
<td>7</td>
<td>47.58</td>
<td>36.30</td>
<td>44.99</td>
<td>179</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>90</td>
<td>0</td>
</tr>
<tr>
<td>Patient 3</td>
<td>49</td>
<td>7</td>
<td>43.75</td>
<td>37.85</td>
<td>34.79</td>
<td>102</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Patient 4</td>
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<td>33.60</td>
<td>31.49</td>
<td>21.16</td>
<td>41</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
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<td>Patient 5</td>
<td>43</td>
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<td>58.57</td>
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<td>25.11</td>
<td>89.80</td>
<td>53</td>
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<td>1</td>
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<td>0</td>
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<td>Patient 7</td>
<td>56</td>
<td>7</td>
<td>38.96</td>
<td>34.23</td>
<td>41.57</td>
<td>312</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>270</td>
<td>20</td>
</tr>
<tr>
<td>Patient 8</td>
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<td>6</td>
<td>39.68</td>
<td>34.74</td>
<td>28.05</td>
<td>39</td>
<td>5</td>
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<td>0</td>
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<tr>
<td>Patient 9</td>
<td>46</td>
<td>7</td>
<td>51.00</td>
<td>46.00</td>
<td>19.37</td>
<td>377</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>140</td>
<td>0</td>
</tr>
</tbody>
</table>

MELD = Model for End-Stage Liver Disease Score; BMI = body mass index; %EWL = percent excess weight loss.
required insulin, two were able to discontinue insulin, and the third demonstrated a 93% reduction (270 U/day to 20 U/day).

**Conclusion:** By adhering to strict pre-operative guidelines, laparoscopic sleeve gastrectomy is a safe and effective means of weight loss in cirrhotic patients awaiting transplantation. Application of these guidelines will lead to improvement of obesity-related conditions in the cirrhotic population and potentially eliminate their need for liver transplantation.

**LO 20**

**BLOOD TRANSFUSION IS RISK FACTOR FOR SHORT-TERM POSTOPERATIVE MAJOR COMPLICATIONS IN PEDIATRIC LIVING DONOR LIVER TRANSPLANTATION**


**Hospital das Clinicas from University of Sao Paulo, Sao Paulo, Brazil**

**Objective:** Our aim was to evaluate if perioperative red blood cells (RBC) transfusion during pediatric living donor transplantation (PLDLT) increases postoperative complications, and if so, to investigate risk factors for transfusion.

**Methods:** We retrospectively evaluated 240 children with up to 20 kg, who underwent elective PLDLT in one single center. Patients were divided according to grade of postoperative (30 days) complications (modified Clavien-Dindo classification). In LCo (n = 107), patients presented lower grade complications (0–IIIa), and in HCo group (n = 133), major complications (IIb–V). Cut-point of RBC transfusion volume (27.6 ml) related to major complications was calculated with ROC curve and patients were evaluated according to volume of RBC transfusion in low transfusion (LRBC, < 27.6 mL/kg) and high transfusion (HRBC, ≥ 27.6 mL) groups.

**Results:** HCo group showed increased RBC, fresh frozen plasma, and platelets transfusion, preoperative bilirubin, intraoperative lactate, and ICU and hospital stay, and decreased height, weight, and age, preoperative glucose and sodium, perioperative hemoglobin, and albumin, compared to LCo group. Multiple logistic regression identified perioperative transfusion and height as significant variables. Pearson’s coefficient analysis showed high RBC transfusion positive correlation with preoperative PELD, intraoperative crystalloid infusion and lactate, and graft-to-recipient-body-weight-ratio, and negative correlation with height, weight, age, and preoperative sodium and lactate.

Gamma generalized linear model height and crystalloid infusion as significant risk factors for transfusion. Survival was significantly decreased in HRBC group (Figure).

**Conclusion:** RBC transfusion increases the risk for postoperative complications in PLDLT. Child height and volume of crystalloid are independent risk factors for transfusion in PLDLT. Strategies do reduce RBC transfusion may decrease surgical morbidity and mortality.

**Figure** Overall survival of patients (A) and graft (B). Comparison between low RBC transfusion group and high RBC transfusion group. P < 0.001.

**LO 21**

**ASSESSING RELATIVE COST OF COMPlications FOLLOWING ORTHOTOPIC LIVER TRANSPLANT**

N. Bhutiani, P. Philips, C. Scoggins, K. McMasters and R. Martin

**University of Louisville, Louisville, KY, USA**

**Objective:** Advances in surgical technique and immunosuppression, along with improvements in anesthesiology and critical care, have improved safety and decreased the complications associated with orthotopic liver transplantation (OLT), post-operative complications continue to impose a clinical and financial burden on patients and the healthcare system. This study sought to identify the frequency and economic impact of complications following OLT.

**Methods:** The Premier Hospital Database was queried for patients undergoing OLT between 2008 and 2015. Complications were identified based on ICD-9 code and grouped based on complication type. Complication frequency as well as impact on clinical and economic outcomes was calculated. Cost differences were calculated with respect to patients undergoing OLT who did not experience each given complication. Differences were averaged within complication types. Complication frequency and effect on cost were ranked, with ranks summed to evaluate relative economic impact of complication types.

**Results:** A total of 2747 patients met inclusion criteria. The most common groups of complications following OLT were pulmonary, bleeding, and infectious (Table 1). The complications with the greatest average percent effect on treatment-related costs were pulmonary, hepatic, and bleeding. After combining the ranks of complication frequency and percent of effect on cost, pulmonary, bleeding, and infectious complications had the greatest cumulative effect on cost related to OLT.

**Conclusion:** Financially significant complications following OLT stem from a combination of post-operative factors. Efforts focused on preventing coagulopathic bleeding, improving post-operative pulmonary toilet and intravenous fluid administration, and minimizing sources of infection can help improve cost-effectiveness of OLT.

**Figure** Overall survival of patients (A) and graft (B). Comparison between low RBC transfusion group and high RBC transfusion group. P < 0.001.
Table 1 Most Frequent and Financially Significant Complications following Orthotopic Liver Transplant

<table>
<thead>
<tr>
<th>Complication group</th>
<th>Percent</th>
<th>Rank of frequency</th>
<th>Average effect on cost (%)</th>
<th>Rank of effect on cost</th>
<th>Combined rank</th>
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</thead>
<tbody>
<tr>
<td>Pulmonary</td>
<td>63.19</td>
<td>1</td>
<td>0.17</td>
<td>1</td>
<td>2</td>
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<tr>
<td>Bleeding</td>
<td>44.45</td>
<td>2</td>
<td>0.09</td>
<td>3</td>
<td>5</td>
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<tr>
<td>Infectious</td>
<td>37.28</td>
<td>3</td>
<td>0.08</td>
<td>4</td>
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<tr>
<td>Hepatic</td>
<td>4.88</td>
<td>8</td>
<td>0.14</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Renal</td>
<td>34.88</td>
<td>4</td>
<td>0.03</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Iatrogenic</td>
<td>7.77</td>
<td>7</td>
<td>0.06</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>19.35</td>
<td>6</td>
<td>0.01</td>
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<tr>
<td>Cardiac</td>
<td>22.61</td>
<td>5</td>
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<td>Neurologic</td>
<td>1.71</td>
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<td>0.02</td>
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<td>17</td>
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<td>Deep vein thrombosis/pulmonary embolus</td>
<td>1.68</td>
<td>11</td>
<td>−0.03</td>
<td>7</td>
<td>18</td>
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<tr>
<td>Psychiatric</td>
<td>3.38</td>
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</tr>
</tbody>
</table>

LO 22
EVALUATION OF TRENDS OF HPB FELLOWSHIPS IN NORTH AMERICA
I. Siddiqui, A. Sastry, E. Baker, J. Martinie, D. Vrochides and D. Iannitti
Carolinas Medical Center, Charlotte, NC, USA

Objective: There are 23 Hepatopancreaticobiliary (HPB) fellowship programs in North America accredited by the Fellowship Council. This study aims to evaluate individual fellows’ experience in training.

Methods: A multiple choice questionnaire with one single best answer was formulated to assess various areas of training including academics, research, exposure to minimally invasive and ablative techniques, autonomy, mentorship and perceived strengths and weaknesses.

Results: 24 fellows completed the survey. 67% had structured didactics. 42% had mandatory research requirements. 39% had training in minimally invasive liver (MIS) surgery. While 95% used intraoperative ultrasound, 41% used it on a regular basis. 63% used ablation in the OR with 22% laparoscopically. RFA was the most common ablation modality (36%) while irreversible electroporation was the least common (4.5%). 21% had training in robotic HPB surgery. 88% had mentorship and 80% had operative autonomy. 76% rated their program as excellent. Lack of exposure to portal hypertension surgery (41%) and absence of robotic training (32%) were the main weaknesses identified.

Conclusion: Although majority of fellows found their training to be excellent, there seems to be a need to improve exposure to minimally invasive HPB surgery with emphasis on robotics as well as exposure to ablative technologies. The fellows seem satisfied with autonomy and mentorship avenues, however would like to see more in terms of multi-institutional research and exposure to surgery for portal hypertension. This can likely be achieved with provision of crossover rotations amongst different accredited programs.

LO 23
A MATTER OF PERCEPTION OR MISCONCEPTION?
HEPATOPANCREATICOBILIARY (HPB) FELLOWS AND GENERAL SURGERY RESIDENTS (GSR) REFLECT ON THE FELLOW’S IMPACT ON THEIR TRAINING
J. Pasko, E. Maynard, C. K. Enestvedt and S. Orloff
Oregon Health and Science University, Portland, OR, USA

Objective: With the evolution of GSR training, we have seen an increase in graduates pursuing fellowships. While training of the GSR is valuable, there has been an emerging focus on educating fellows and sharing GSR cases. Our aim was to evaluate the role of the HPB fellow with respect to GSR training and to determine each group’s perception of the role of the fellow on resident education.

Methods: Two surveys were created to evaluate both fellows’ and GSRs’ perception of the fellow’s impact on GSR education. HPB fellows and PGY 3–5s at the 18 AHPBA accredited fellowships were invited to participate. Survey was conducted on Survey Monkey. Statistics were computed with a Fischer’s test.

Results: 15/35 (42.9%) fellows and 11/18 (61%) institutions (59 residents) responded to the survey. Fellows and GSR average cases were 58.5 liver, 26.7 complex biliary and 52 pancreas vs. 5 liver, 5 complex biliary, and 6 pancreas, respectively. 78.9% of fellows compared to 32.2% GSRs (p < 0.01) felt fellows contributed to GSR education. When asked if they hindered GSR experience, 71.4% fellows vs. 50% GSRs (p = NS) responded no. Open-ended questions sought strategies to improve GSR and fellow experience, which yielded an array of responses.

Conclusion: Effective learning environments for fellows and GSRs are of utmost importance. Our study reveals a disconnect between resident and HPB fellows’ perception.

Table 1 Most Frequent and Financially Significant Complications following Orthotopic Liver Transplant
of fellows’ impact on GSR training. Future efforts must focus on establishing an environment where perception meets reality.

**LO 24**

**JOB MARKET FOR HPB GRADUATES NOT AS BAD AS WE THINK – SURVEY OF RECENT HPB FELLOWSHIP GRADUATES**

E. Cho, H. Osman, A. Chapates and D. Jeyarajah
Methodist Medical Center, Dallas, TX, USA

**Objective:** Increasing numbers of Hepato-pancreatico-biliary (HPB) fellowship graduates enter the workforce each year. Studies have proposed that the number of HPB surgeons will outgrow the demand in the US. The purpose of this study is to portray practice composition, career choices and job satisfaction of recent HPB fellowship graduates.

**Methods:** A 21-questions survey was sent out to recent HPB fellowship graduates (graduated in years 2011–2015) through an online electronic survey software. Descriptive statistics were generated for aggregate survey responses.

**Results:** We had a 75% response rate to our survey. 60% of the responders finished another fellowship in addition to an HPB fellowship. 90% of the graduates received 1 to 3 job offers (Figure 1). 46.7% of graduates accepted an academic job while 40% accepted a mix of academic and private job. Salary accepted varied widely. 56.7% of responders perform mostly HPB cases in their new job (Figure 2). 90% of the graduates are still working at their first job since completion of fellowship. 96.7% of responders believe that completion of HPB fellowship helped secure their intended practice.

**Conclusion:** Our survey shows that recent fellowship graduates are obtaining academic or private surgical positions with competitive salaries. A great majority of HPB graduates seem satisfied with their first job out of fellowship and almost all believe that HPB fellowship experience played an integral role in helping secure their intended practice.

**LO 25**

**ESTABLISHMENT OF A DEDICATED LIVER TRANSPLANT/HEPATOBILIARY SURGERY SERVICE INCREASES RESIDENT EXPERIENCE IN NON-TRAUMA AND PANCREATIC SURGERY**

M. Mahoney, C. Anderson and T. Earl
University of Mississippi Medical Center, Jackson, MS, USA

**Objective:** We sought to examine the establishment of a formal hepatopancreatobiliary rotation and service on resident experience in hepatopancreatobiliary (HPB) surgery.

**Methods:** In July 2012, an HPB service and chief resident rotation was established at our center. Resident experience in liver, biliary, and pancreas cases were collected from

![Figure 1](image1.png) **Figure 1** Number of job offers that graduates received after completion of fellowship.

![Figure 2](image2.png) **Figure 2** Types of case performed by fellowship graduates in their current job.
Results: Forty-seven resident case logs were included in the study. Total HPB cases for finishing residents increased after the establishment of a formal HPB rotation (20.6 ± 4.7 vs. 35.5 ± 13.5; p < 0.001). Mean chief resident cases increased from 8.0 ± 4.0 to 23.7 ± 12.3 (P < 0.001). Major liver and pancreas resections excluding trauma were higher in Group 2 for total case volume (6.4 ± 2.9 vs. 13.6 ± 6.1; p < 0.001) and chief resident case volume (3.7 ± 2.2 vs. 10.5 ± 5.2; p < 0.001) compared with Group 1. Increases in major biliary, pancreas and liver resections were seen over time. Group 2 had significantly higher numbers of major non-trauma pancreas resections (total: 4.1 ± 2.4 vs. 7.1 ± 3.5; p = 0.001, chief: 2.6 ± 2.1 vs. 5.7 ± 2.9; p < 0.001) and hepatic lobectomy/trisegmentectomy (total: 2.3 ± 1.4 vs. 6.5 ± 3.8, p < 0.001, chief: 1.1 ± 0.9 vs. 4.8 ± 3.2; p < 0.001).

Conclusion: Establishment of a formal HPB service and resident rotation increases resident experience in major, non-trauma HPB surgery. The increase appears due to increase in formal liver and pancreatic resections and not due to transplant-related procedures.

LO 26
IS SURGERY LAGGING BEHIND IN MEDICAL EDUCATION? SURVEY OF MEDICAL STUDENTS ON THEIR PERCEPTION OF ATTENDINGS DURING CLERKSHIP ROTATIONS

E. Cho, D. Dietemann, H. Osman and D. Jeyarajah
Methodist Medical Center, Dallas, TX, USA

Objective: Stereotypes about surgery can pervade through the medical school, negatively altering the perception of students prior to their clerkship experience. We sought to investigate whether those perceptions, positive or negative, existed for each of the core specialties and whether those perceptions improved after completing their clerkships.

Methods: A 13-question Likert scale questionnaire was distributed to M1–4 medical students at a single osteopathic institution in year 2016. M1–2 were surveyed for their opinion going into clerkships in ER, internal medicine, family medicine, ob/gyn, pediatrics, psychiatry and surgery and M3–4 were surveyed for their opinion after clerkship completion. Descriptive analysis of the data was performed.

Results: Overall perception of students regarding faculty was lowest for surgery compared to other core specialties. Surgery was the only clerkship where the overall perception of surgical faculty fell significantly from pre-completion to post-completion of clerkships (Figure 1). Medical students felt that surgical faculty showed the least interest in teaching, in displaying patience to the students, and in displaying interpersonal skills to students and other staff.

Conclusion: Surgery continues to be a challenging rotation to the medical students, with pre-clerkship perception being the lowest among all medical disciplines. Disturbingly, the students’ perception of the surgical faculty’s interpersonal skills and willingness to interact with and teach medical students fell after completion of rotation. This survey serves as a reminder to the teaching faculty to serve as a role model for the medical students.

LO 27
RECRUITED CD11B+LY6G+ IMMATURE MYELOID CELLS PROMOTE LIVER REGENERATION FOLLOWING MAJOR LIVER RESECTION

N. Pencovich, Y. Bogoch, O. Amar, E. Bondar, N. Zohar, J. M. Klausner and I. Nachmany
Tel-Aviv Sourasky Medical Center, Tel-Aviv, Israel

Objective: Liver regeneration necessitates sequential activation of multiple pathways and cell types involving the entire remaining organ in recovery of mass. Proliferation of parenchyma is intimately dependent on concomitant angiogenesis. The role of circulating myeloid cells in hepatic angiogenesis and regeneration is yet to be defined. CD11b+Ly6G+ immature myeloid cells (IMCs) promote tumors angiogenesis and play role in normal developmental processes that necessitate rapid vascularization. Here we assessed the role of IMCs in liver regeneration following major resection in mice.

Methods: Two-thirds hepatectomies were performed in BALB/c mice, and the IMCs populations within the peripheral blood and remnant livers were analyzed during regeneration. IMCs were blocked using an anti-Ly6G antibody, and liver weights, liver functions, liver morphology, hepatocyte proliferative capacity, and vasculature formation were assessed. IMCs were magnetically separated from regenerating livers on POD1-4 and the global gene-expression patterns were evaluated by RNA-sequencing.

Figure 1 Perception of students on various medical clerkships before and after rotations (1 = least tolerant and patient, 4 = most tolerant and patient).
Results: IMCs accumulated within regenerative livers compared to control livers, starting at POD2 and increasing up to POD4 (3.31 ± 0.6 fold-change, P = 0.0002). Blocking of IMCs led to increased mortality (51% vs. 9%, P = 0.002), liver mass reduction, aberrant hepatocyte morphology and liver functions, as well as disruption of vascular integrity. RNA sequencing of IMCs revealed profound changes in gene expression on POD1−4 compared to IMCs following sham operations. Key pathways and master regulators were differentially expressed, including those related to angiogenesis.

Conclusion: IMCs accumulation following major resection promotes liver regeneration by establishing proper vasculature. This data turn a spotlight at IMCs as potential target for therapies aiming to augment liver regeneration.

LO 28
IMPACT OF LYMPH NODE ASSESSMENT ON SURVIVAL IN RESECTED INTRAHEPATIC CHolangiocarcinoma: AN ANALYSIS USING THE NATIONAL CANCER DATABASE

Washington University School of Medicine, St. Louis, MO, USA

Objective: Although lymph node (LN) involvement is a known predictor of survival in intrahepatic cholangiocarcinoma, the benefit of LN dissection has been debated. We sought to evaluate the effect of LN assessment on survival using the US National Cancer Database (NCDB).

Methods: Patients undergoing resection with curative intent for intrahepatic cholangiocarcinoma were identified from the NCDB, 2004−2012. Variables of interest included LN sampling (LNS; any number of nodes) and number of LNs sampled (nLNS). Multivariable logistic regression, Kaplan−Meier analysis, and Cox proportional hazards regression modeling were used to assess the effect of these variables on receipt of adjuvant chemotherapy and overall survival.

Results: 2902 patients met eligibility criteria. Median follow-up was 24 months. 1,531 patients (53%) underwent LNS. The median number of LNs examined was three (interquartile range, IQR, 1 5). 146 patients (10%) were upstaged from clinic node-negative to pathologic node-positive disease. Node-positive disease was an independent predictor of mortality (5-year OS 12% vs. 39%, p < .01, HR 2.3, 95% Confidence Interval, CI, 2.0 2.6). On multivariate analysis, patients undergoing LNS were more likely to receive adjuvant therapy (28% vs 17%, p < .01, OR 1.5, 95% CI 1.1 2.0), although LNS was not associated with 5-year OS (p = 0.10). There was no threshold at which the number of lymph nodes sampled was associated with improved OS.

Conclusion: LN involvement is a prognostic indicator in intrahepatic cholangiocarcinoma and LNS is associated with receipt of adjuvant chemotherapy. However, the extent of LNS is not associated with OS.

LO 29
CYTOREDUCTIVE DEBULKING SURGERY AMONG PATIENTS WITH NEUROENDOCRINE LIVER METASTASIS: A MULTI-INSTITUTIONAL ANALYSIS

The Ohio State University, Columbus, OH, USA

Objective: Management of neuroendocrine liver metastasis (NELM) in the setting of unresectable disease is poorly defined and the role of debulking remains controversial. The objective of the current study was to define outcomes following non-curative intent liver-directed therapy among patients with NELM across 8 international institutions.

Methods: 612 patients were identified who underwent liver-directed therapy of NELM from a multi-institutional database. Outcomes were stratified according to curative (R0/R1) versus non-curative ≥80% debulking (R2).

Results: Ninety-five (15.5%) patients had an R2/debulking procedure. Patients undergoing debulking more commonly had liver disease burden that was bilateral (R0/R1: 57.7% vs. R2: 71.1%; P = 0.02) with a subset of patients having >50% involvement of the hepatic parenchyma (R0/R1: 20.8% vs. R2: 19.3%; P = 0.18). Over one-quarter of patients who underwent debulking had extra-hepatic disease (R0/R1: 8.7% vs. R2: 26.3%; P < 0.001). Patients underwent liver resection alone (R0/R1: 79.1% vs. R2: 65.3%) ablation alone (R0/R1: 2.9% vs. R2: 0%) or a combined approach (R0/R1: 18.0% vs. R2: 34.7%) (P < 0.001). After a median follow-up of 51 months, median (R0/R1: not reached vs. R2: 89.2 months; P < 0.001) and 5-year survival (R0/R1: 81.9% vs. R2: 58.7%; P < 0.001) was higher among patients who underwent an R0/R1 resection compared with patients who underwent a debulking operation. Among patients with >50% NELM liver involvement, median and 5-year survival following debulking was 77.9 months and 53.4%, respectively.

Conclusion: Debunking operations for NELM provided reasonable long-term survival. Hepatic debulking for patients with NELM is a reasonable therapeutic option for patients with grossly unresectable disease that may provide a survival benefit.

LO 30
OVERALL SURVIVAL FOLLOWING RESECTION VERSUS TRANSPLANT FOR HILAR CHolangiocarcinoma: SYSTEMATIC REVIEW AND META-ANALYSIS

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Objective: A systematic review following PRISMA guidelines was performed searching for English articles comparing OS of resection and OLT published in the last 20 years. Nine studies providing 1, 3, and 5 year OS were identified. A meta-analysis was performed in order to
compare mortality and OS. The statistical analysis was conducted using RevMan software and Random Effects Model due to heterogeneity among the studies’ groups. 

**Results:** Nine studies including 200 OLT and 398 resection patients were included. Five studies demonstrated favorable 5 year OS following OLT. Meta-analysis of all studies demonstrated a trend toward improved 1, 3 and 5 year survival for OLT (78% vs 72.5%, 55.5% vs 44%, 46% vs 31%), but this did not achieve statistical significance with mortality Odds Ratios (ORs) and 95%CI of 0.93 [0.59—1.47], 0.74 [0.41—1.34], and 0.72 [0.30—1.69], respectively. Only 6/9 studies reported margin status. Of these, 271/344 (79%) patients were R0. No resection patients received neoadjuvant therapy, while all OLT patients received neoadjuvant chemotherapy and radiation in 2/9 studies. These two studies demonstrated the highest OLT 5 year OS at 59% and 82%. Importantly, 28—48% of patients started on neoadjuvant never made it to OLT. Including these patients, OS dropped to approximately 35% and 44%, respectively.

**Conclusion:** These data do not support the use of OLT over resection for de novo resectable HCCA. Patient selection via neoadjuvant therapy may account for much of the perceived improvement in OS. Future studies should explore whether neoadjuvant therapy should be administered routinely prior to resection.

**LO 31**

**OVERALL BODY COMPOSITION AND SARCOPENIA ARE ASSOCIATED WITH POOR LIVER REGENERATION FOLLOWING PORTAL VEIN EMBOLIZATION**

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*The University of Texas, MD Anderson Cancer Center, Houston, TX, USA*

**Objective:** To evaluate the relationship of body composition/sarcopenia with liver regeneration following portal vein embolization (PVE) for colorectal liver metastases (CLM).

**Methods:** A homogeneous cohort of 45 hepatectomy-naïve patients with CLM who underwent right PVE were identified. Advanced imaging software measured the following body compartments, which were standardized to height (m2): skeletal muscle index (SMI), subcutaneous adipose index (SAI), visceral adipose index (VAI), and adipose index (AI). SMI, gender, and body mass index were used to define sarcopenia, as previously published. Patient factors and body composition indices were compared to the kinetic growth rate (KGR) of the future liver remnant (FLR) using standard statistical techniques.

**Results:** Study patients were evenly divided into three KGR groups: lower third (KGR: 0.7—2.0%), middle third (KGR: 2.0—4.1%), and upper third (KGR: 4.2—12.3%). Patients in the lower third KGR group had a lower VAI (31.0 vs 53.0 vs 54.5, P = 0.042), lower VAI/Al ratio (.26 vs .47, P = .002), and a higher SAI/Al ratio (.73 vs .53, P = .042). Eighteen patients (40%) met criteria for sarcopenia. Sarcopenic patients had a lower SMI (39.2 vs 56.8, P = <.001), lower VAI (29.1 vs 57.4, P = .004), lower VAI/Al ratio (.26 vs .47, P = .003), and higher SAI/Al ratio (.74 vs .53, P = .003). Sarcopenia was associated with a lower post-PVE FLR volume (36.5% vs 41.7%, P = .007) and lower KGR (8.3% vs 15.2%, P = .009).

**Conclusion:** Sarcopenia and associated body composition indices are strongly associated with clinically relevant impaired liver regeneration, thus multiple body compartments should be measured to predict liver-specific complications following hepatectomy for CLM.

**LO 32**

**INVOLVEMENT OF CHEMOKINE RECEPTOR EXPRESSION AND LYMPH NODE METASTASIS IN DISTAL CHOLANGIOCARCINOMA**

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**Objective:** Lymph node (LN) metastasis is the critical factor that defines poor prognosis of distal bile duct cancer. Recently LN metastasis of cancer cells is considered to take advantage of the mechanism of lymphocyte homing regulated by the CCL21-CCR7 axis. The aim of the present study is to explore whether distal bile duct cancer cells express CCR7 and analyze a possible association with LN metastasis.

**Methods:** 34 patients with distal bile duct cancer including 18 patients with LN metastasis and 16 without treated with pancreatoduodenectomy at our department between 2002 and 2008 were included in this study. Immunostaining was conducted using anti-CCL21, anti-CCR7, and anti-LN antigen.
done with resected specimens to examine the expression level of chemokine receptor CCR7 in cancer cells and elucidate whether the expression level is associated with lymph node metastasis. CCR7 staining was evaluated by visual assessment.

**Results:** The membrane of distal bile duct cancer cells were heterogeneously immunostained by antibody for CCR7. 18 of 34 cases were positive for CCR7 expression (53%). 17 of 18 cases with lymph node metastasis were positive whereas 9 of 16 cases without lymph node metastasis were positive (p = 0.0019 by Fisher’s exact test). When the staining level was categorized into 3 groups as negative, moderately positive and strongly positive (1, 4 and 13 patients with LN metastasis, and 9, 6 and 1 without, respectively) the statistical difference expanded (p = 0.000029 by Mann-Whitney U test).

**Conclusion:** The expression level of CCR7 in distal bile duct cancer cells could be one of the factors that promote lymph node metastasis.

**LO 33**

**IMPACT OF ADJUVANT CHEMOTHERAPY ON SURVIVAL IN PATIENTS WITH INTRAHEPATIC CHOLANGIOCARCINOMA: A MULTI-INSTITUTIONAL ANALYSIS**


*The Ohio State University, Columbus, OH, USA*

**Objective:** The benefit of adjuvant chemotherapy on surgically resected intrahepatic cholangiocarcinoma (ICC) is poorly understood. We sought to investigate the impact of adjuvant chemotherapy on survival in surgically resected ICC patients using a multi-institutional database.

**Methods:** 1,087 ICC patients who underwent liver resection between 1990 and 2016 were identified from 13 participating institutions. Cox proportional hazard modeling was used to determine the impact of adjuvant systemic therapy on long-term overall survival.

**Results:** Among 1,087 patients who underwent resection, median age was 59 and 54.6% patients were male. Most patients underwent major hepatectomy involving ≥3 liver segments (n = 664, 61.1%) and 194 (17.8%) patients had lymph node metastasis. Following surgery, 331 (30.4%) patients received adjuvant chemotherapy, most commonly a gemcitabine-based regimen (n = 197, 59.5%). Patients treated with adjuvant chemotherapy were more likely to have advanced disease, including a higher incidence of T3/4 tumors [81 (24.5%) vs. 88 (12.6%)], poorly differentiated/undifferentiated histology [93 (28.1%) vs. 98 (14.0%)], lymph node metastasis [96 (29.0%) vs. 88 (12.6%)], and positive margins [64 (19.3%) vs. 74 (10.6%)] (all P < 0.001). Median and 5-year survivals for the entire cohort were 37.4 months and 39.6%, respectively. Receipt of adjuvant chemotherapy was not associated with median survival among the entire cohort (35.5 vs. 45.2 months; P > 0.05). However, among patients with lymph node metastasis, receipt of adjuvant chemotherapy was associated with a decreased risk of death long-term [HR 0.32, 0.17—0.63; P < 0.005].

**Conclusion:** Following resection of ICC, patients with advanced disease were more likely to be treated with adjuvant chemotherapy. While chemotherapy did not impact survival among all patients, it was associated with improved survival among high-risk patients with nodal metastasis.

**LO 34**

**ELEVATED MCP-1 IS ASSOCIATED WITH CANCER CACHEXIA IN PATIENTS WITH PANCREATIC DUCTAL ADENOCARCINOMA**


*The Ohio State University, Columbus, OH, USA*

**Objective:** There is a high prevalence of cachexia in pancreatic ductal adenocarcinoma (PDAC). We sought to evaluate a panel of 25 cytokines/chemokines in PDAC with and without weight loss prior to exploration to identify associations with cachexia.

**Methods:** Peripheral blood was obtained from patients in a prospective study undergoing exploration for PDAC without prior neoadjuvant therapy. Patients were divided into cachectic (≥5% weight loss) and non-cachectic. A
panel of 25 cytokines/chemokines were tested for association with cachexia. Clinical and pathological characteristics were obtained and analyzed relative to the plasma biomarkers.

**Results:** 55 patients with PDAC without prior neoadjuvant therapy were enrolled, including 36 (65%) with cachexia. The median age was 66 years and 26 (40%) were female. On univariate analysis increased MCP-1 (p = 0.016), decreased GMCSF (p = 0.029), and decreased FGF2 (p = 0.049) were associated with cachexia. MCP-1 was the only of those also associated with survival, whereas cachexia was not associated with overall survival. On multivariate analysis, MCP-1 over median (143 pg/ml) is an independently associated with cachexia. Age, gender, nodal status, positive margin, poor histologic differentiation, and T stage were not associated with cachexia.

**Conclusion:** Increased MCP-1 is associated with cancer cachexia in patients with PDAC. MCP-1 may be an early biomarker for cachexia in this patient population and possible therapeutic target for treatment of cancer associated cachexia. Further exploration of the role of MCP-1 in cancer-related cachexia is needed.

**LO 35**

**BEHIND THE CYST: PREDICTING GRADE OF DYSPLASIA IN INTRADUCTAL PAPILLARY MUCINOUS NEOPLASMS (IPMNS) BY QUANTITATIVE IMAGE ANALYSIS**


Memorial Sloan Kettering Cancer Center, New York, NY, USA

**Objective:** IPMNs are precancerous cysts that are radiographically-identifiable precursor lesions of pancreatic cancer. Routine resection is recommended when main duct dilation is present. For cases of branch duct IPMN (BD-IPMN), management guidelines remain controversial. This study analyzes whether preoperative computationally-derived imaging features of BD-IPMNs could distinguish low-risk (low- and intermediate-grade dysplasia) from high-risk (high-grade dysplasia and invasive carcinoma) disease.

**Methods:** In patients who underwent resection for IPMN between 2005 and 2015, 103 patients had a pathologically-proven BD-IPMN and an adequate preoperative pancreatic CT angiogram. Image features were extracted using texture analysis—a well-known method for capturing changes in image heterogeneity—and a novel algorithm developed at our institution. Significant features on univariate analysis and clinical variables known to be associated with high-risk disease (age, cyst size, solid component/mural nodule, GI/ pain symptoms, and gender) were combined to build a prediction model. Ten-fold cross-validation was applied to calculate an overall average concordance-index (c-index).

**Results:** Within the study group of 103 patients, 76 had low-risk disease, and 27 had high-risk disease. Computationally-derived variation in CT enhancement and focal areas of high intensity throughout the cyst were the most predictive texture features. The c-index for a preliminary model based solely on clinical variables was 0.67; model accuracy improved with the addition of texture features (c-index: 0.79).

**Conclusion:** Quantitative image analysis of BD-IPMNs is a novel method that may identify high-risk lesions in resected patients. Expanding our cohort to include unresected patients and applying external validation may strengthen our model and provide a reliable non-invasive predictive tool for clinicians.

**Figure 1** Above: Component separation of focal areas of high intensity from the CT image for low and high risk lesions. Below: Receiver operating characteristic (ROC) curve for prediction of high-grade dysplasia. Area under curve (AUC, or c-index) for clinical features: 0.67 (red). AUC for combined model: 0.79 (blue).
LO 36
A MURINE MODEL OF MICROMETASTATIC PANCREAS CANCER
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Objective: Pancreas cancer (PC) maintains a high mortality rate due to early metastatic spread to the liver. We have developed a murine model of metastatic PC designed to monitor the progression of a single micrometastatic (mM) cell, and are able to characterize the changes in the liver microenvironment in the presence of single mM cells.

Methods: The murine PC cell line KCKO was transfected to express both Green Fluorescent Protein (GFP) and B-Galactosidase (B-Gal). Mice underwent orthotopic pancreas tumor implantation with luciferase-labeled KCKO. Seven days later, the mice underwent a second stage surgery involving primary tumor resection, splenic injection of KCKO/GFP/B-Gal, followed by hemi-splenectomy. At varying time points thereafter (24, 48, & 72 hours) the mice were sacrificed and individual liver lobes were processed.

Results: B-Gal expressing mM single tumor cells can be seen in liver tissue sections by X-gal staining. Analysis of the liver tumor microenvironment (TME) at time points after splenic injection revealed an increase in myeloid cells by flow cytometry, immunofluorescence, and immunohistochemistry. There was an up regulation of tumor-promoting and immunosuppressive genes by RT-PCR. Using CCR2−/− mice, there was a noted decrease of the myeloid cell infiltrate and mM in the liver TME, reinforcing the importance of the mobilizing signal of the CCR2−/−/CCL2 chemokine axis.

Conclusion: We developed a mouse model to recapitulate early micrometastatic PC occurrence in the liver after primary tumor resection. We can use this model to assess the progression of single cell liver mM and associated changes in the liver TME.

LO 37
EN BLOC CELIAC AXIS AND EXTENDED CELIAC AXIS RESECTION WITH AND WITHOUT REVASCULARIZATION FOR PANCREATIC ADENOCARCINOMA (PDAC): THE MAYO CLINIC EXPERIENCE
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Objective: Celiac axis resection (CAR) for PDAC may offer oncologic benefit in selected patients. Extended CAR and need for revascularization may impair perioperative and oncologic outcomes.

Methods: Our database was queried for PDAC pancreatoduodenectomy with CAR. Survival analysis included perioperative and oncologic deaths.

Results: Thirty-three celiac axis resections performed (DP = 27; TP = 6) with neoadjuvant chemotherapy in 23(70%). CAR only in 22 (67%) patients and extended CAR with HA and/or SMA in 11(33%). Revascularization was required in 16 (48%) patients with 5 (15%) unanticipated due to intraoperative ischemia. Concurrent venous resections occurred in 19 (59%). Multivisceral resection was performed in 18 (55%). 90-day mortality was 12% (4 pts.) and major morbidity (≥Grade IIIB) was 36% (12 pts.). Gastric or hepatic ischemia occurred in 5 and 6 patients respectively with 3 and 4 patients requiring reoperation/revascularization. R1 resection in 4 (12%) pts, all without chemoradiation. Pathological responses were Grade 0/1 in 39% of neoadjuvant cases. Median OS/RFS was 20.9/17.9 months respectively. Median OS/RFS was significantly greater (30.2 vs 8; 26.2 vs 2.9; p = 0.0001) after neoadjuvant induction chemotherapy versus upfront surgery/adjuvant therapy. Univariate predictors of survival in neoadjuvant cohort: extended chemotherapy (>4 cycles), CA19-9 normalization, and Grade 0/1 path response. Only multivariate predictor of survival was extended chemotherapy (>4 cycles; p = 0.01). Mortality, morbidity, and survival were similar between all cohorts (resection only vs. revascularization and CAR only vs. extended CAR resections).

Conclusion: Extent of CAR or need for revascularization does not negatively influence outcomes. Survival after CAR for PDAC is favorable only in the neoadjuvant setting with extended duration induction chemotherapy.

<table>
<thead>
<tr>
<th>Male vs. female</th>
<th>48% (16) vs. 52% (17)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevated CA19-9 at Dx</td>
<td>58% (19)</td>
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<tr>
<td>Neoadjuvant chemotherapy</td>
<td>70% (23)</td>
</tr>
<tr>
<td>Neoadjuvant chemotherapy then chemoradiation</td>
<td>58% (19)</td>
</tr>
<tr>
<td>Median no. of chemo cycles</td>
<td>6 cycles</td>
</tr>
<tr>
<td>Median age at surgery</td>
<td>67 years</td>
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<tr>
<td>Median BMI</td>
<td>26</td>
</tr>
<tr>
<td>Open vs. laparoscopic</td>
<td>85% (28) vs. 15% (5)</td>
</tr>
<tr>
<td>Distal vs. total pancreatectomy</td>
<td>82% (27) vs. 18% (6)</td>
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<tr>
<td>Celiac only resection</td>
<td>67% (22)</td>
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<tr>
<td>Extended celiac resection</td>
<td>33% (11)</td>
</tr>
<tr>
<td>Celiac resection alone</td>
<td>52% (17)</td>
</tr>
<tr>
<td>Resection and revascularization</td>
<td>48% (16)</td>
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<tr>
<td>Celiac only resection with revascularization</td>
<td>15% (5)</td>
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<tr>
<td>Concurrent vein resection</td>
<td>61% (20)</td>
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<tr>
<td>Multivisceral resection</td>
<td>55% (18)</td>
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<td>Median estimated blood loss</td>
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<tr>
<td>PRBC transfusion</td>
<td>67% (22)</td>
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<td>Median operative time</td>
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<tr>
<td>Median no. LN’s removed</td>
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<tr>
<td>% Positive LN’s</td>
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<td>R1 margin status</td>
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<td>Grade 0/1 vs. 2/3 pathologic response</td>
<td>39% (9) vs. 61% (14)</td>
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<td>Any ICU admission</td>
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<tr>
<td>Any complication</td>
<td>73% (24)</td>
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<td>≥ Grade IIIB Comp</td>
<td>36% (12)</td>
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<tr>
<td>Grade B/C POPF</td>
<td>21% (7)</td>
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<tr>
<td>Grade B/C PPH</td>
<td>15% (5)</td>
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LO 38
NATIONAL COMPARISON OF SHORT-TERM SURGICAL OUTCOMES FOR OPEN VS MINIMALLY INVASIVE PANCREATICODUODENECTOMY: A PROPENSITY SCORE MATCHED ANALYSIS

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Objective: To evaluate short-term surgical outcomes for minimally invasive (MIS) vs open pancreaticoduodenectomy (PD) for which national studies are lacking.

Methods: ACS-NSQIP targeted pancreas database queried for patients who underwent PD in 2014. Approach categorized as planned open vs intention-to-treat MIS. One-to-one propensity score matching used to account for selection bias in pre-operative and intra-operative characteristics.

Results: 2400 patients were identified, of whom 195 (8.1%) underwent MIS PD. Patients who underwent MIS were more likely to be: white (85.6% vs 80.1%; p = 0.047) and male (56.4% vs 51.2%; p = 0.16), and less frequently preoperatively biliary stented (45.1% vs 51.9%; p = 0.071). Gland texture, duct size, diagnosis (benign neoplasm, malignant, other), and 30-day mortality were not significantly different. Of note, no information on surgeon experience or hospital volume available. MIS more likely to result in pancreatic fistulae (24.6% vs 17.5%; p = 0.013), longer operative time (median 435 vs 361 mins; p < 0.0001), but shorter LOS (median 7 vs 8 days; p = 0.034). After matching, cohort consisted of 390; pancreatic fistulae remained significantly higher for MIS (24.6% vs 13.3%; p = 0.005). ISGPF grade not available; however, SSI, and mortality equivalent in matched cohort (Figure). Operative time remained longer (median 435 vs 357 mins; p < 0.001). Trend observed for increased delayed gastric emptying in MIS (20.0% vs 12.8%; p = 0.056).

Conclusion: Matched comparison of MIS-PD using national data demonstrated prolonged operative time, higher rates of pancreatic fistulae and no difference in LOS. These results taken in context of more favorable single- and multi-institutional data may suggest deployment of MIS pancreaticoduodenectomy should be rigorously selective, based on criteria that might include surgeon, center, and patient metrics.

LO 39
HYPERSPECTRAL IMAGING BASED ON COMPRESSIVE SENSING TO DETERMINE CANCER MARGINS IN HUMAN PANCREATIC TISSUE EX VIVO

Carolinas Medical Center, Charlotte, NC, USA

Objective: Pancreatic adenocarcinoma (PA) is the fourth-leading cause of cancer-related mortality in the United States, with a 5-year survival rate <10%. Surgical resection is the most widely-utilized treatment for pancreatic adenocarcinoma. Locally advanced lesions frequently invade vasculature and surrounding tissue, making R0 resections challenging. We sought to develop a single-pixel, hyperspectral imaging system based on compressive sensing for tumor margin detection.
LO 40

PROSTAGLANDIN E2: A PANCREATIC FLUID BIOMARKER OF IPMN DYSPLASIA

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Objective: With the increased frequency of diagnostic imaging, pancreatic cysts are now detected in >2% of the American adult population. Intraductal papillary mucinous neoplasm (IPMN) are cystic lesions of the pancreas with a well-established potential to develop into pancreatic adenocarcinoma. Clinical management of pancreatic IPMN would be facilitated by the identification of biomarkers that correlate with dysplastic grade; however, to date, few exist. We previously reported that prostaglandin E2 (PGE2) levels in pancreatic cyst fluid may differentiate malignant tissue from non-tumor tissue. A reflectance image formed from the ratio at 450 nm and 500 nm was sensitive to malignant tissue and showed excellent correlation to margins as determined following pathological analysis.

Conclusion: Single-pixel hyperspectral imaging represents a novel technology to map tumor and non-tumor margins with high confidence.

Methods: Freshly-resected pancreatic tissue from 10 patients with a diagnosis of presumptive PA were analyzed. A spectral imaging system comprising of a nitrogen laser (autofluorescence) and halogen lamp (reflectance) were used to generate spectra from tumor, non-tumor and tumor/non-tumor borders. Changes in autofluorescence and reflectance spectra were used to delineate tissue from tumor and non-tumor pancreas, and these data were compared to H&E stained sections following blinded scoring by a board-certified pathologist.

Results: Our data indicated significant changes in both reflectance and autofluorescent spectra in non-tumor and tumor tissue from PA resections. Reflectance spectra was elevated at 450 nm in tumor tissue and decreased at 550 nm compared to non-tumor tissue. Autofluorescent spectra were elevated as a result of increased collagen (400 nm) and nicotinamide adenine dinucleotide phosphate (NAD(P)H) (475 nm) in tumor tissue compared to non-tumor tissue. A reflectance image formed from the ratio at 450 nm and 500 nm was sensitive to malignant tissue and showed excellent correlation to margins as determined following pathological analysis.

LO 41

ARE PATIENTS ADEQUATELY INFORMED AND FOLLOWED FOR ABNORMAL IMAGING FINDINGS OF THE LIVER AND PANCREAS?

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Objective: Abnormal hepatic, pancreatic, or biliary (HPB) findings may be found in up to 15% of patients undergoing computed tomography (CT) imaging. We sought to determine the incidence of new clinically significant findings (NCSF) in this group. We also sought to discover the frequency at which patients were informed and received follow-up for HPB NCSF during Emergency Department (ED) visits in a community setting.

Methods: CT scan reports were retrospectively reviewed during a 2-month period, January—February 2016. Chart reviews were conducted to determine if any abnormal HPB findings were new or clinically significant. In cases of NCSF, any mention of the finding in the medical chart was documented, and patients were then contacted by phone survey.

Results: 659 CT scans were performed during this time period and 81 (12.3%) had abnormal HPB findings, including 28 (34.6%) with non-CSF, 19 (23.4%) with previously known CSF, and 34 (41.9%) with NCSF. Among those with NCSF, the abnormality was not mentioned in the final impression of the radiology report 41.2% of the time nor any ED documentation 55.9% of the time. Chart review revealed that 18/34 patient records had no mention of follow-up for HPB findings and these patients were contacted by phone survey. Eleven patients were successfully contacted, and 9/11 were not aware of their HPB NCSF on imaging. All 9 patients (100%) did request additional follow-up.

Conclusion: Patients with abnormal HPB findings do not consistently receive appropriate education and follow-up for such findings. Additional tracking measures or educational tools may benefit these patients.

LO 42

RECURRENT HEPATOCELLULAR CARCINOMA AFTER RADIOFREQUENCY ABLATION OR LIVER RESECTION CAN BE TREATED WITH SALVAGE TRANSPLANTATION

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Objective: Liver resection (LR) and radiofrequency ablation (RFA) represent curative therapies for early stages of hepatocellular carcinoma (HCC). If tumour recurrence progression. Pending prospective evaluation, the inclusion of such biomarkers in a diagnostic panel may facilitate risk stratification of patients with IPMN.
occurs, salvage liver transplant (SLT) may constitute a treatment option. We aimed to assess the long-term outcomes of patients that were transplanted for recurrent HCC after curative-intent therapies (LR or RFA).

Methods: We conducted a matched-control (1:1) cohort study comparing patients with HCC treated with primary liver transplant (PLT) to SLT after recurrence following curative-intent treatment. Matching was performed according to the size and number of viable tumours at explant pathology following liver transplant. Patients that received LR or RFA as a “bridge to transplant” were not included.

Results: Between Nov 1999—Dec 2014, 561 patients with HCC were transplanted at our Institution. The matched-cohort was composed of 49 SLT patients (24 LR and 25 RFA) and 49 PLT patients. The median time to recurrence after LR or RFA in the SLT group was 13 months (1–143). No significant differences were observed in demographic or tumor characteristics between the PLT and SLT groups, except for the median MELD at time of transplant [PLT 13 (6–29) vs. SLT 8 (6–19), p < 0.005]. The 5-year cumulative risk of recurrence after LT was 19% in the PLT vs. 33% in the SLT group, p = 0.17. The 5-year actuarial survival after PLT was 66% vs. 68% in the SLT group, p = 0.77.

Conclusion: SLT is an acceptable treatment for recurrent HCC following curative-intent therapies with comparable long-term recurrence rates and patient survival.

LO 43
OUTCOMES AFTER VASCULAR RESESECTION DURING CURATIVE RESECTION FOR HILAR CHOLANGIOCARCINOMA: A MULTI-INSTITUTIONAL ANALYSIS FROM THE US EXTRAHEPATIC BILIARY MALIGNANCY CONSORTIUM

Washington University School of Medicine, St. Louis, MO, USA

Objective: To determine the impact and efficacy of vascular resection on outcomes in patients with hilar cholangiocarcinoma (HC).

Methods: We analyzed patients from the ten institutions of the U.S. Extrahepatic Biliary Malignancy Consortium who underwent resection with curative intent for HC between 1998 and 2015. Patients were grouped based on vascular resection: no vascular resection, portal vein resection (PVR), and/or hepatic artery resection (HAR).

Results: 253 patients underwent curative-intent resection for HC, of which 35 (14%) underwent single-vessel VR. 20 patients (8%) who underwent PVR and 15 patients (6%) who underwent HA. Two patients underwent PVR + HAR. Median follow-up was 21 months. The overall complication rate was 66%, which did not vary significantly by VR status (p = 0.73). 30-day mortality was 6% (n = 15), and while patients who underwent PVR has a trend towards higher 30 day mortality (3/20; 15%) compared to patients who underwent HA without PVR (0%), this did not reach statistical significance (p = 0.08). 5-year OS was not statistically different based on VR status (Table). OS for no VR, PVR and HA groups = 72%, 74% and 85% at one year, and 18%, 0% and 11% at five years; p = 0.74.

Conclusion: In a modern, multi-institutional cohort of patients undergoing curative-intent resection for HC, a minority of patients underwent concomitant VR. Patients who underwent PVR trended towards higher 30-day mortality, but this did not reach statistical significance. VR was not associated with differences in survival. Careful selection based on patient and tumor factors should guide treatment recommendations for patients with HC requiring VR.

<table>
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<tr>
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<th>No vascular resection (n = 218)</th>
<th>Portal vein resection (n = 20)</th>
<th>Hepatic artery resection (n = 15)</th>
<th>p Value</th>
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<tr>
<td>1-year OS</td>
<td>72%</td>
<td>75%</td>
<td>85%</td>
<td>0.74</td>
</tr>
<tr>
<td>5-year OS</td>
<td>18%</td>
<td>0%</td>
<td>11%</td>
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</table>
HMGB1 release and activated TLR9-dependent pathways in cancer cells to promote their adhesion, proliferation, migration, and invasion.  

**Conclusion:** Our findings implicate NET in the development of liver metastases after surgical stress, suggesting that their elimination may reduce risks of tumor relapse.

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**LO 45**

**THE IMPACT OF GOAL DIRECTED INTRAOPERATIVE FLUID ADMINISTRATION DURING PANCREATICODUODENECTOMY ON PANCREATIC LEAKS AND DELAYED GASTRIC EMPTYING**

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*Carolinas Medical Center, Charlotte, NC, USA*

**Objective:** In patients undergoing pancreaticoduodenectomy (PD), optimal fluid balance is critical in minimizing intraoperative anastomotic edema. In this study, we examine the effects of decreased fluid administration, prior to the PD reconstructive phase, on the rate of postoperative pancreatic leak and delayed gastric emptying (DGE).

**Methods:** 54 consecutive patients that underwent PD from January through December of 2015 at a single institution were retrospectively reviewed. Patients with vascular reconstruction were not included. During each case, non-invasive monitoring was performed with Edwards Vigileo system and anastomoses were performed within 2 hours of abdominal closure. Average stroke volume variation (SVV), SVV up to the last 2 hours of the operation (SVV1), and SVV for the last 2 hours of the operation (SVV2) were recorded. A comparative analysis of postoperative complications was performed between patients with a SVV ≥12 and those with a SVV <12.

**Results:** Out of 54 patients, 41 (76%) patients had a SVV <12 and 13 (24%) had a SVV ≥12. As the average SVV and SVV2 increased, there was a trend towards decreased fluid administration (p = 0.57 and p = 0.07, respectively). Compared to patients with SVV1 <12, those with a SVV1 ≥12 demonstrated numerically less postoperative pancreatic leaks (26.8% vs. 7.7%, p = .148) and numerically less DGE (23.1% vs. 53.7%, p = 0.054).

**Conclusion:** Goal directed restricted fluid administration before the reconstructive phase of PD decreases incidence of pancreatic leak and delayed gastric emptying.

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**LO 46**

**MAJOR HEPATECTOMY FOR PERIHILAR CHOLANGIOCARCINOMA IN THE ELDERLY: ONCOLOGICALLY ADVANTAGEOUS, BUT PROCEED WITH CAUTION**

*Stanford University School of Medicine, San Francisco, CA, USA*

**Objective:** As the U.S. population ages, an increasing number of elderly patients are being evaluated for surgical resection of gastrointestinal malignancy. This study aims to evaluate short- and long-term outcomes after major hepatectomy for perihilar cholangiocarcinoma in the geriatric population.

**Methods:** Patients who underwent major hepatectomy for perihilar cholangiocarcinoma were retrospectively identified using the U.S. Extrahepatic Biliary Malignancy Consortium database. Patients were stratified into two groups based on age at the time of surgery (age >75 and age <75). Patient factors, tumor characteristics, operative outcomes, and survival were evaluated.

**Results:** Of 210 patients who underwent resection of perihilar cholangiocarcinoma from 2000—2014, 41 (20%) patients age were >75 years old. Margins, T-stage, N-stage, presence of lymphovascular invasion (LVI) and tumor grade were similar in the two groups. Postoperative morbidity (77.5% vs. 68%, p = 0.34) and 90-day mortality (22% vs. 10%, p = 0.09) were higher in older patients, but did not reach statistical significance. Overall survival was significantly worse in those older than 75 years (5-year, 14.5% vs 22%, P = 0.003), but disease-specific survival rates were comparable between the two groups (5-year, 47.9 vs. 38.5%, P = 0.74, Figure). On multivariate analysis, only advanced stage, but not age or presence of LVI, was an independent predictor of poor survival.

**Conclusion:** Failure-to-rescue from complications is substantial for patients older than 75 years undergoing major hepatectomy for perihilar cholangiocarcinoma. However, if the operation can be performed safely, the long-term cancer-specific outcome appears similar to that of younger patients.

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![Graphs showing overall and disease-specific survival for patients with and without age >75.](attachment:image.png)
NEOADJUVANT CHEMOTHERAPY VERSUS CHEMORADIOThERAPY FOR RESECTABLE PANCREATIC HEAD ADENOCARCINOMA: A PROPENSITY SCORE MATCHED ANALYSIS

University of Texas, Southwestern Medical Center, Dallas, TX, USA

Objective: Recent reports showed a survival benefit following neoadjuvant therapy compared to upfront resection for resectable pancreatic adenocarcinoma (PDAC). However, there is limited data as to whether neoadjuvant chemotherapy (nCT) or chemoradiotherapy (nCRT) constitute optimal neoadjuvant treatment. This study compares overall survival between nCT and nCRT in patients with resectable pancreatic cancer.

Methods: Adult patients that received neoadjuvant therapy followed by clinical stage I or II head PDAC were identified in the National Cancer Database between 2006 and 2012. Patients that received nCT were matched by propensity score with patients that had nCRT. Overall survival as well as early postoperative outcomes were compared.

Results: We identified 2,021 patients (nCT: 743, nCRT: 1,278 patients) that received neoadjuvant treatment followed by resection for early-stage PDAC. From the nCT group, 689 patients (93%) were matched with 689 patients that had nCRT. Overall survival was similar between the nCT and nCRT groups (median survival, 28 vs 27 months; P = 0.26; hazard ratio, 1.08; 95% CI, 0.94 to 1.24; Figure 1). In the nCRT group, patients had smaller tumors (pT3 and pT4: 77% vs 63%; P < 0.01), less lymph node involvement (61% vs 36%; P < 0.01), and less positive resection margins (20% vs 14%; P < 0.01). Following resection, patients in the nCRT group received less adjuvant chemotherapy (41% vs 27%; P < 0.01), though they had higher 90-day postoperative mortality (4% vs 7%; P < 0.01).

Conclusion: nCRT for resectable PDAC is associated with decreased tumor size, nodal involvement, and positive margins without significant difference in overall survival when compared to nCT.

BLOOD TRANSFUSION IS THE MOST CRITICAL DETERMINANT OF RESOURCE UTILIZATION AND TOTAL HOSPITAL COST IN LIVER TRANSPLANTATION

University of Kentucky, Lexington, KY, USA

Objective: The aim of this study is to identify factors associated with increased resource use and total hospital cost after liver transplantation.

Methods: A retrospective study of isolated liver transplantation patients undergoing surgery between January 2008 and December 2013 was performed.

Results: Patients undergoing LT alone (191 patients) were included in the analysis. Creatinine and blood transfusion were significantly associated with prolonged LOS, ICU LOS on the ventilator. Multivariable predictors of log-transformed costs included creatinine by descending order of Total Hospital Cost were comprised of O.R., ICU, pharmacy, floor, diagnostics, and ancillary services. After controlling for intraoperative factors such as operative time and blood transfusions we found that transfusions were the strongest independent predictors of total cost. Patients receiving less than 5 units of PRBCs had a median LOS of 7 days. Also in our study, ICU LOS doubled and ICU total cost increased by 50% if patients required more than 5 transfusions of PRBCs.

Conclusion: Care should be taken when assessing transplantation costs to the possible contribution of pre-transplantation activities in the cost accounting. Elevated serum creatinine and blood transfusions are the most critical determinants of increased resource utilization and hospital expenditure in liver transplantation.
LO 50
REDUCTION OF CARDIOPULMONARY-RENAL COMPLICATIONS WITH SERUM BRAIN NATRIURETIC PEPTIDE-GUIDED VOLUME STATUS MANAGEMENT IN POST HEPATECTOMY PATIENTS
S. Patel, B. Kim, C. Tzeng, Y. Chun, C. Conrad, J. Vauthey and T. Aloia
University of Texas, MD Anderson Cancer Center, Houston, TX, USA

Objective: Cardiopulmonary complications and acute kidney injury after hepatectomy are major causes of perioperative morbidity and mortality. Serum brain natriuretic peptide (BNP) levels have been shown to parallel changes in fluid balance during the perioperative period and unlike serum creatinine or urine output, are not affected by alterations of the hormonal axis or fluid third-spacing. We sought to reduce the incidence of post hepatectomy cardiopulmonary-renal complications using a serum BNP-guided hepatobiliary fluid protocol

Methods: Patients registered in the ACS NSQIP hepatectomy database between 2011 and 2016 at a single institution were examined in real-time for the development of cardiopulmonary-renal complications and divided into pre (2011–2013) and post (2014–2016) institution of a BNP-guided hepatobiliary fluid protocol groups.

In the first 24 hours postoperatively, patients were resuscitated with D5NS + 16mmoles KPhos and changed to D51/2NS + 16mmoles KPhos for the remaining postoperative course with a declining rate. If patients had an elevated BNP > 200 pg/ml, fluid rate was further decreased/stopped and diuresis considered. If BNP 100–200 pg/ml, no additional intervention was needed, and if <100 pg/ml, additional fluid bolus was administered

Results: Four hundred twenty-nine patients underwent hepatectomy in the study period with 251 patients in the pre and 178 patients in the post protocol implementation groups. Cardiopulmonary-renal complication rates were 4.0% in the pre protocol group and reduced to 1.1% after initiation of the BNP-guided hepatobiliary fluid protocol (p = 0.07)

Conclusion: Despite low event rates, these data suggest that goal-directed postoperative fluid therapy with the combination of a hepatobiliary fluid protocol and serum BNP-guided volume management is superior to traditional bedside volume assessment and can reduce post hepatectomy cardiopulmonary-renal complications

LO 51
EFFECT OF PERIOPERATIVE TRANSFUSION ON SURVIVAL AND RECURRENTENCE AFTER RESECTION OF GALLBLADDER CANCER: A 10-INSTITUTION STUDY FROM THE U.S. EXTRAHEPATIC BILIARY MALIGNANCY CONSORTIUM
Emory University, Atlanta, GA, USA

Objective: Perioperative blood transfusion is associated with poor outcomes in several malignancies. Its effect in gallbladder cancer (GBC) is unknown.

Methods: All patients with GBC who underwent curative-intent resection at 10-institutions from 2000 to 2015 were included. The effect of blood transfusion on overall survival (OS) and recurrence-free (RFS) was evaluated.

Results: Of 449 patients with GBC, 295(66%) underwent curative-intent resections. Median age was 66 yrs, and 61 patients (23%) received perioperative blood transfusions. Radical cholecystectomy was the most common procedure in both groups (80%), but major hepatectomy was more common in the transfusion versus no-transfusion group (13 vs 4%; p = 0.02). The transfusion group was less likely to have incidentally-discovered disease (57 vs 74%) and receive adjuvant therapy (29 vs 48%), but more likely to have preoperative jaundice (23 vs 11%), T3/T4 tumors (60 vs 39%), LVI (71 vs 40%), PNI (71 vs 48%), and major complications (39 vs 12%) (all p < 0.05). Transfusion was associated with lower median OS compared to no-transfusion (20 vs 32 mos; p < 0.001; Figure), which persisted on multivariable (MV) analysis (HR: 2.1; 95%CI 1.1–3.9; p = 0.03), controlling for comorbidities, serum albumin, INR, preoperative jaundice, major hepatectomy, incidental discovery, margin status, T-Stage, LN status, and major complications. Median RFS of transfused patients was 12 mo compared to 49 mo for non-transfused patients (p = 0.1). Transfusion, however, was an independent predictor of decreased RFS on MV analysis (HR: 2.3; 95%CI 1.1–5.1; p = 0.04). Volume and timing of transfusion were not associated with OS or RFS.

Conclusion: Perioperative blood transfusion is associated with decreased overall and recurrence-free survival after resection for gallbladder cancer, after taking into account other adverse factors. Transfusions should be administered in the context of well-defined guidelines and protocols.
LO 52
DEVELOPMENT OF A PUBLIC LIVER CENTER UNIT: IMPACT ON LIVER TRANSPLANTATION RATES
G. Quiñones, R. Vergara, M. Poupard, N. Daciuk, A. Cristiano, M. Lenz, F. Villamil and F. Mattera
Hospital el Cruce Alta Complejidad en Red, Buenos Aires, Argentina

Objective: Establish associations between a 40 month period of work of a public liver center unit and characteristics of liver transplant recipients before and after that period.

Methods: Retrospective data was collected from the data base SINTRA/INCUCAL. Comparison between: 1—01/05/2009—31/12/2012 (before Hospital El Cruce/HEC) and 2—01/01/2013—31/08/2016 (after HEC). The outcomes evaluated were: total transplants performed and divided by public/private centers, access to list, 24 h mortality, organ assignment order, waiting list time/WLT, donor per million habitants. Comparisons were performed by Wilcoxon Rank Sum test.

Results: the median amount of transplant in Argentina during the last 6 years was 107 in each 4 month-period. In our center, 142 interventions were realized, with a median of 13 per 4 months; this represents 40% of the liver transplants/LT performed in public centers, and 11% across the country. There was statistical difference in the MELD score to access a LT (24 vs 26, p 0,0210), WLT (46 vs 72 days p 0,0012), donors per million (15 vs 13 p 0,0049), patients being transplanted in a public center (19 vs 30 p 0,0011). No difference was observed in the transplants performed across Argentina, at private centers, MELD/Emergency status, organ assignment order and 24 h mortality.

Conclusion: MELD score and LTs performed in public centers increased; without impact in the global amount, and despite the drop of donors. WLT also increased. Outcomes might be explained by the access of sicker patients to waiting list that could not access previously and the aggressiveness of the liver unit that uses organs beyond previous rates.

LO 53
RESECTION OF INTRAHEPATIC CHOLANGIOCARCINOMA: DEFINING LONG-TERM SURVIVORS USING A LARGE MULTI-CENTER INTERNATIONAL COHORT
The Ohio State University, Columbus, OH, USA

Objective: Intrahepatic cholangiocarcinoma (ICC) is an aggressive primary tumor of the liver. While surgery remains the cornerstone of therapy, long-term survival following curative-intent resection is generally poor with 5-year survival ranging from 30 to 35%. The aim of the current study was to define the incidence of actual long-term survivors, as well as identify clinicopathological factors associated with long-term survival.

Methods: Patients who underwent a curative-intent liver resection for ICC between 2009 and 2016 were identified using a multi-institutional database. Overall, 765 patients were alive with ≥5 years of follow-up or had died during follow-up. Prognostic factors among patients who were long-term survivors (LTS) (overall survival [OS] ≥5) were compared with patients who were not non-long term survivors (non-LTS) (OS <5).
Results: Among the 765 patients who met eligibility criteria, 3- and 5-year OS were 50.9% (95% CI, 47.7–54.1) and 38.1% (95% CI, 34.6–41.7), respectively. Overall, 564 (73.7%) patients were non-LTS while 201 (26.3%) were LTS. Factors associated with non-surviving to 5-years included perineural invasion (OR 2.93, 95% CI, 1.53–5.59), intrhepatic metastasis (OR 6.79, 95% CI, 1.60–28.8), satellite lesions (OR 2.68, 95% CI, 1.58–4.58), and direct invasion of an adjacent organ (OR 4.00, 95% CI, 1.56–10.3) (all p ≤ 0.001). However, a subset of patients who had these pathological characteristics were LTS. Specifically, 20 LTS (9.9%) had perineural invasion, 23 (11.4%) had satellite lesions, 5 (2.5%) had intrhepatic metastasis, and 6 (2.9%) had direct invasion of adjacent organ. Among those LTS who survived to at least 5 years, 7- and 10-year survival was respectively 78.5% (95% CI, 69.0–85.4) and 51.2% (95% CI, 36.9–63.7), respectively. Among LTS assessed at 5 years, 54 (26.9%) LTS recurred; 32 (15.9%) patients recurred after 5 years from the date of surgery.

Conclusion: While ICC is generally associated with a poor prognosis, some patients will be LTS. In fact, even a subset of patients with traditional adverse prognostic factors survived long-term.

LO 54
CUSTOMIZED PREDICTIVE ALGORITHMS FOR OUTCOMES OF CHOLECYSTECTOMY AT A HIGH-VOLUME CENTER

M. Fruscione, R. Kirks, A. Cochran, K. Murphy, E. Baker, J. Martinie, D. Iannitti and D. Vrochides
Carolinas Medical Center, Charlotte, NC, USA

Objective: The American College of Surgeons NSQIP® Risk Calculator estimates postoperative risk. Using the NSQIP-predicted complication rates to analyze outcomes for patients undergoing cholecystectomy, we identified significant discrepancies compared to data for patients treated at our high-volume HPB-surgery center. The aim of this study was to develop/validate an institution-specific predictive outcomes model for cholecystectomy.

Methods: From 2008 to 2015, 143 patients deemed too high risk for acute care surgery (ACS) had cholecystectomies performed by the Division of Hepatopancreatobiliary Surgery (HPB). Outcomes for HPB surgery were matched against 126 cholecystectomies performed by ACS. NSQIP-generated outcome predictions were recorded and analyzed. Based on these data new predictive models for 6 postoperative outcomes were constructed. Brier score and area under the curve (AUC) were used to assess predictive accuracy for both models and internal validation was performed using bootstrap logistic regression. Logistic regression models were constructed using bivariate (p < 0.25) and multivariate (p < 0.05) analyses. Model accuracy was validated using retrospective and prospective data.

Results: HPB surgeons performed cholecystectomy on a higher acuity population with poorer predicted postoperative outcomes compared with ACS. Brier scores showed little difference in the predictive ability of the NSQIP and our models. For ACS cholecystectomy, our model better predicted mortality, surgical site infection, and cardiac complication (AUC: 0.9450.978, p < 0.05). For HPB cholecystectomy, our model better predicted 5/6 postoperative outcomes versus NSQIP (NSQIP AUC: 0.5740.764, p > 0.05; institute-specific AUC: 0.7790.982, p < 0.01).

Conclusion: For higher acuity patients undergoing cholecystectomy, customized models are superior for predicting individual perioperative risk and allow more accurate, patient-specific delivery of care.

Table 1 Comparison of predictive capacity of ACS-NSQIP® and Institute-Specific risk-prediction models for postoperative complications of cholecystectomy performed at a high-volume center by Acute Care Surgery and Hepatopancreatobiliary Surgery

<table>
<thead>
<tr>
<th></th>
<th>NSQIP Calculator</th>
<th>CMC Model</th>
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<tr>
<td></td>
<td>AUC</td>
<td>AUC</td>
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<tr>
<td></td>
<td>p value</td>
<td>p value</td>
</tr>
<tr>
<td><strong>Cholecystectomy performed by Acute Care Surgery</strong></td>
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<td></td>
</tr>
<tr>
<td>Serious complication</td>
<td>0.6116</td>
<td>0.1552</td>
</tr>
<tr>
<td>30-day readmission</td>
<td>0.6771</td>
<td>0.0474</td>
</tr>
<tr>
<td>30-day mortality</td>
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<tr>
<td>Cardiac complication</td>
<td>0.6290</td>
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<tr>
<td><strong>Cholecystectomy performed by Hepatopancreatobiliary Surgery</strong></td>
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<tr>
<td>Serious complication</td>
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<td>Discharge to nursing facility</td>
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<tr>
<td>Cardiac complication</td>
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</table>

Abbreviations: ACS-NSQIP, American College of Surgeons National Surgical Quality Improvement Program; AUC, Area under the curve.
LO 55
RISK SCORE TO PREDICT SERIOUS POSTOPERATIVE MORBIDITY AND MORTALITY AFTER LIVER RESECTION IN NONCIRRHOTIC PATIENTS

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Objective: To develop a risk score to predict serious postoperative complications after hepatic resection in non-cirrhotic patients.

Methods: Multivariate logistic regression analysis was used to develop risk score to predict severe complications (Clavien-Dindo class, III–V) after 502 liver resections performed in non-cirrhotic patients at a single tertiary care center (2005–2015). Model calibration and discrimination were tested using Hosmer–Lemeshow test and C-statistics respectively.

Results: The rate of serious complications was 22.8% (Grade III, 69 (13.3%); Grade IV, 48 (9.5%)) while mortality was (3.8%). Multivariable predictors of postoperative complications included sex (male; odds ratio (OR) 1.42), hepatitis C (OR 3.22), diabetes (OR 1.45), hypertension (OR 1.67), ECOG performance status >1 (OR 2.15), albumin (<3.5 mg/dl; OR 3.09), extrahepatic reconstruction (biliary or vascular OR 12.0; bowel resection OR 1.85; other procedures OR 1.43), and extent of liver resection (two-segment OR 1.38; three-segment OR 1.85; four-segment OR 3.95; five-segment OR 6.27). The risk score accurately predicted postoperative serious complications (discrimination (C-statistics 0.79) and calibration (p = 0.28)) and the risk score categories were associated with serious morbidity (category 0–2 6%; 3–4 13.7%; 5–6 23%; ≥7 53%, P < 0.001), readmission rate (category 0–2 6%; 3–4 11.5%; 5–6 18.3%; ≥7 35%, P < 0.001) and mean length of hospital stay (category 0–2 4.2 days; 3–4 5.5 days; 5–6 6.1 days; ≥7 9.8 days, P < 0.001).

Conclusion: The risk score had high discriminative ability to predict serious postoperative complications in non-cirrhotic patients undergoing liver resection. These data will assist surgeons, patients and their families in making informed decision when hepatic resection is being contemplated.

LO 56
SURVIVAL AFTER RESECTION OF PERIHILAR CHOLANGIOCARCINOMA IN PATIENTS WITH LYMPH NODE METASTASES

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Objective: Previous studies found that patients resected for perihilar cholangiocarcinoma (PHC) with lymph node metastases (LN+) almost always develop recurrent disease. In this study we compared resected LN+ patients with patients with locally advanced non-metastatic PHC who did not undergo resection.

Methods: Consecutive LN+ patients who underwent a resection for PHC in 12 centers were compared with patients with locally advanced PHC from 2/12 centers. Locally advanced PHC was defined as main or bilateral hepatic arterial involvement, or Bismuth IV or main portal vein involvement in high surgical risk patients.

Results: A total of 119 patients had a resection for PHC and LN+ at pathological evaluation. Median patient age was 68 years (IQR: 58–74) and most patients were male (n = 355; 62.1%). At the time of surgery, most patients (n = 100; 84.7%) underwent a major hepatic resection. Surgical margin status was R0 in 76 patients (64.4%). T-stage across LN+ patients was pT0/pT1 (18.8%), pT2 (41.6%), pT3 (29.7%), and pT4 (9.9%). In the LN+ cohort 26 (21.8%) patients were alive after a median follow-up of 24.0 months. LN+ patients were compared with 453 patients who had locally advanced disease. The median overall survival (OS) of LN+ patients was 19.2 months versus 10.3 months for patients with locally advanced disease (p < 0.001); 5-year OS was 12.5% versus 2.9%.

Conclusion: Although PHC patients who underwent a resection for LN+ disease had a median OS of only 19 months, this OS was superior to non-resected patients. Therefore we conclude that, while resection is not curative for these patients, it is life prolonging.
LO 57
STAGED RESECTION OPTIMIZES PATIENT SELECTION FOR AGGRESSIVE SURGERY IN PATIENTS WITH SYNCHRONOUS LIVER AND LUNG COLORECTAL METASTASES

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Objective: Resection of isolated liver and lung metastases from colorectal cancer can offer potential cure of the disease. However, the treatment strategy in patients with synchronous liver and lung metastases (L+L) still remains controversial. We aimed to assess the clinical implication of staged liver and lung resection for L+L.

Methods: Database of 865 consecutive liver resections performed for colorectal liver metastases was reviewed. Among them, 87 patients had L+L. Our treatment strategy for L+L was to consider indication of lung resection 3 months after liver resection (staged lung resection). Long-term outcomes were compared among L+L patients with and without staged lung resection.

Results: Among the 87 patients with L+L, lung resection was performed for 48 (55%). The remaining 39 did not undergo lung resection because of: progression of lung metastases (n = 14), liver metastases (n = 4), liver and lung metastases (n = 4), and other distant metastases (n = 7). 10 patients had unresectable lung metastases when liver resection had been performed. The 5-year overall survival rate after liver resection of L+L patients without lung resection (32.2%) was worse than that of L+L patients with lung resection (66.2%, p<0.01), which was comparable to that of 778 patients without lung metastases (56.9%, p = 0.49).

Conclusion: Our strategy of staged liver and lung resection is reasonable to select a subset of patients who benefit from lung resection. Staged liver and lung resection for L+L can offer prognosis comparable to that of patients with liver metastases alone.
LO 59
SURGICAL PRACTICE PATTERNS AND OUTCOMES IN T2 AND T3 GALLBLADDER CANCER: INSIGHTS FROM A POPULATION BASED STUDY
S. Tharmalingam, J. Flemming, H. Richardson, D. Hurbut and S. Nanji
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Objective: To describe management and outcomes in patients with resected T2 and T3 gallbladder cancer (GBC) in the general population of Ontario, Canada.
Methods: All cases of resected T2 and T3 GBC from 2002 to 2012 were identified using the Ontario Cancer Registry. Electronic treatment records and pathology reports were linked to the registry to describe surgical management and pathologic findings. Type of resection was classified as ‘extended’ (cholecystectomy + liver resection +/- bile duct resection) or ‘simple’ (cholecystectomy only).
Results: 24% (56/232) of T2 cases and 37% (51/138) of T3 cases underwent an extended resection. Unadjusted overall 5-year survival for simple vs extended resection was 39.7% vs 49.5% for T2 GBC (p = 0.03) and 13.5% vs 22.8% for T3 GBC (p = 0.05). In adjusted analysis of T2 cases, extended resection significantly improved overall survival (HR = 0.51, 95% CI 0.30 to 0.97), while higher grade of differentiation, presence of lymphovascular invasion and positive lymph nodes lead to worse survival. In adjusted analysis of T3 cases, only younger age and female gender significantly improved overall survival, along with a strong trend for node negative disease. Extended resection demonstrated a trend for improved survival among node negative cases (HR = 0.20, CI 0.03–1.06).
Conclusion: The use of extended resection for T2 and T3 GBC in Ontario is modest and overall survival is comparable to high-volume centres. Extended resection is associated with improved overall survival in all T2 disease and limited to node negative T3 disease.

LO 60
PREDICTING THE TRAJECTORY OF POST-HEPATECTOMY LIVER DYSFUNCTION (PHLD)
Y. Qian, T. Clements, J. M. Aubin, F. Sutherland, C. G. Ball, E. Dixon and O. Bathe
University of Calgary, Calgary, Canada
Objective: PHLD is an expected outcome with extensive liver resections, and it remains a major cause of morbidity. Early recognition of severe cases may be beneficial. The International Study Group of Liver Surgery (ISGLS) consensus criteria for post-hepatectomy liver failure serve to identify individuals with significant liver dysfunction. However, because the diagnostic criteria comprise liver dysfunction persisting more than 4 days after hepatectomy, the ISGLS definition is of limited use to a clinician. Our objective was to identify factors that inform the clinician whether PHLD is likely to be accompanied by an adverse clinical course.
Methods: Liver resections between 2006 and 2014 were retrospectively reviewed. Patients with bilirubin ≥40 μmol/L and/or prothrombin time ≥1.5 at any time after surgery were identified. Factors associated with severe complications, ICU admission and death were identified.
Results: During the study period, 1010 liver resections were performed and 110 patients (10.9%) had PHLD. Of those, 76 (69%) met the ISGLS criteria for liver failure. Clavien-Dindo complication grades ≥4 (ICU admission or mortality) occurred in 25 patients (22.7%). Factors associated with those adverse outcomes included patient age (P = 0.015), duration of surgery (P = 0.030), estimated blood loss (P = 0.010), and the need for intraoperative blood transfusions (P < 0.001). The extent of liver resection and presence of cirrhosis did not predict clinical trajectory.
Conclusion: Intraoperative events leading to prolonged surgery and excessive blood loss had the greatest influence on the clinical trajectory of PHLD.

LO 61
LOW SKELETAL MUSCLE DENSITY IS ASSOCIATED WITH EARLY DEATH IN PATIENTS WITH SUSPECTED PERIHILAR CHOLANGIOCARCINOMA
J. van Vugt, M. Gaspersz, J. Vugts, S. Buettner, S. Levolger, R. de Bruin, W. Polak, J. de Jonge, F. Willemssen, B. Groot Koerkamp and J. IJzermans
Erasmus MC University Medical Center, Rotterdam, The Netherlands
Objective: Low skeletal muscle mass is associated with increased postoperative morbidity and impaired survival following liver resection for perihilar cholangiocarcinoma (PHC). However, the majority of patients do not undergo surgery. The aim of this study was to investigate skeletal muscle mass and skeletal muscle density (SMD) as biomarkers to predict the outcome of all patients with PHC, regardless of subsequent treatment.
Methods: All consecutive patients with suspected PHC in a tertiary center were included. Skeletal muscle mass and skeletal muscle density, reflecting intramuscular adipose tissue infiltration and muscle quality (in Hounsfield units), were measured on the level of the third lumbar vertebra (L3) on abdominal CT.
Results: In total, 233 patients were identified with a median follow-up of 25.3 months. In total, 221 (94.8%) patients died during the study period. The 3-month, 6-month, 1-year, 3-year and 5-year survival rates in the entire cohort were 79.0%, 60.9%, 42.1%, 7.7%, and 3.0%, respectively. Median survival did not differ between patients with (11.6 months, 95% CI: 9.2–14.1) and without (11.1, 95% CI: 7.4–14.8) low skeletal muscle mass (p = 0.375), whereas a significantly lower median survival was observed in patients with low (7.0 months, 95% CI: 4.7–9.3) compared with high (12.1, 95% CI: 8.1–16.1) SMD (p = 0.004, figure). Low SMD was independently associated with decreased survival (HR 1.78, 95% CI: 1.03–3.07, p = 0.04) within the first 6 months, but not after 6 months (HR 0.68, 95% CI: 0.44–1.07, p = 0.093).
Conclusion: A time-dependent effect of SMD on mortality was found in patients with PHC, regardless of subsequent treatment. Low skeletal muscle density may identify patients with PHC at risk for early death.
LO 62
EVIDENCE VS PRACTICE IN EARLY DRAIN REMOVAL FOLLOWING PANCREATECTOMY

Baylor College of Medicine, Houston, TX, USA

Objective: Early drain removal when POD1 drain fluid amylase (DFA) was ≤5000 IU/L reduced complications in a previous randomized controlled trial. We hypothesized that most surgeons continue to remove drains late and that this is associated with inferior outcomes.

Methods: We assessed the practice of pancreas surgeons in a prospectively maintained pancreas surgery consortium database to determine the association between timing of drain removal with demographics, co-morbidities, and all complications including clinically relevant post-operative pancreatic fistula (CR-POPF). We excluded patients without drains or POD1 DFA >5000, and if POD1 DFA values or timing of drain removal was unknown. Early drain removal was defined as ≤POD5. Early and late removal groups were compared using Chi square.

Results: 213 patients met all inclusion criteria. Only 74 (35%) had drains removed early. There was no difference between groups in demographics or co-morbidities. EBL was greater in the late group (early 146 mL, late 325 mL; p = 0.008). All other intra-operative characteristics were similar. Complications were significantly increased in the late group (Table 1). There were no CR-POPF or major complications in patients with early removal. When subset analysis was performed for type of resection, complications remained significant for distal pancreatectomy (early (4/29 (14%) vs late 24/35 (69%), p < 0.0001).

Conclusion: Despite level 1 data suggesting improved outcomes with early removal when POD1 DFA is ≤5000, experienced pancreas surgeons more frequently removed drains late. This practice was not explained by known risk factors (except EBL) and may be associated with inferior outcomes suggesting potential for improvement, particularly in distal pancreatectomy.

LO 63
MAKING A FISCAL ARGUMENT FOR THE SUPERIORITY OF MINIMALLY INVASIVE DISTAL PANCREATECTOMY: THE NUMBERS DON’T LIE

University of Wisconsin, Madison, WI, USA

Objective: A growing body of literature has demonstrated the favorable perioperative and equivalent short-term oncologic outcomes of minimally invasive distal pancreatectomy (MIDP). However, how surgical approach influences cost — from insurer and patient perspectives — is unknown.

Methods: Using the MarketScan® databases we identified cases of open (ODP), laparoscopic (LDP), and robotic (RDP) distal pancreatectomy performed for malignant disease using ICD-9 and CPT procedure codes (2013–2014). Cost, defined from a societal perspective to include insurer and patient out-of-pocket (OOP) payment, was determined, inclusive of index hospitalization and any 90-day readmissions.

Results: A total of 892 patients were identified (658 ODP, 126 LDP, 108 RDP). There were no differences in baseline comorbidities between the three groups (Table 1). ODP patients were more likely to have a longer index hospitalization (ODP 6d, LDP 4d, RDP 5d; p < 0.001). All groups

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Comparison of Early and Late Drain Removal Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Early (n = 74)</td>
</tr>
<tr>
<td>Patients with any complication</td>
<td>21 (28%)</td>
</tr>
<tr>
<td>Patients with major complications (Accordian grade ≥3)</td>
<td>0</td>
</tr>
<tr>
<td>Pancreatic fistula (Grade B/C)</td>
<td>0</td>
</tr>
</tbody>
</table>
had similar readmission rates (ODP 16.2%, LDP 14.3%, RDP 13.0%; \( p = 0.62 \)) with similar LOS at readmission; total hospitalization time remained longest in the ODP group (ODP 7d, LDP 4.5d, RDP 5d; \( p < 0.001 \)). ODP had the highest median index hospital payment (ODP $36,135, LDP $30,283, RDP $31,672; \( p = 0.01 \)) and median 90-day total payment (ODP $39,260, LDP $30,616, RDP $33,416; \( p = 0.02 \)) among the three groups.

### Conclusion

This all-payer claims-based analysis demonstrates that MIDP is associated with significantly lower 90-day costs compared to an open approach. These data make a compelling fiscal argument that MIDP “when safe and feasible” should be the preferred approach to distal pancreas malignancies.

### Table 1

<table>
<thead>
<tr>
<th>Pre-operative characteristics</th>
<th>Operative approach</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Open (n = 658)</td>
<td>Laparoscopic (n = 126)</td>
</tr>
<tr>
<td>Male sex, %</td>
<td>45</td>
<td>46</td>
</tr>
<tr>
<td>Age, mean, y (IQR)</td>
<td>61 (15)</td>
<td>59 (15)</td>
</tr>
<tr>
<td>Elixhauser index, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>1</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>17</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>36</td>
<td>35</td>
</tr>
<tr>
<td>Clinical outcomes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median LOS, d (IQR)</td>
<td>6 (4)</td>
<td>4 (2)</td>
</tr>
<tr>
<td>Discharge location/status, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>75.5</td>
<td>79.7</td>
</tr>
<tr>
<td>Home with home health</td>
<td>17.8</td>
<td>13.0</td>
</tr>
<tr>
<td>Transferred to other facility</td>
<td>5.8</td>
<td>6.5</td>
</tr>
<tr>
<td>Deceased</td>
<td>0.9</td>
<td>0.8</td>
</tr>
<tr>
<td>90-day readmission rate, %</td>
<td>16.2</td>
<td>14.3</td>
</tr>
<tr>
<td>Number of readmissions, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>11.7</td>
<td>11.1</td>
</tr>
<tr>
<td>2</td>
<td>3.5</td>
<td>1.6</td>
</tr>
<tr>
<td>3</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>4</td>
<td>0.3</td>
<td>0.8</td>
</tr>
<tr>
<td>Length of stay per readmission, d (IQR)</td>
<td>4 (5)</td>
<td>4.5 (2)</td>
</tr>
<tr>
<td>2</td>
<td>6 (10)</td>
<td>3 (2)</td>
</tr>
<tr>
<td>3</td>
<td>4.5 (5)</td>
<td>5 (22)</td>
</tr>
<tr>
<td>4</td>
<td>4.5 (5)</td>
<td>5 (-)</td>
</tr>
<tr>
<td>Median cumulative LOS, d (IQR)</td>
<td>7 (5)</td>
<td>4.5 (3)</td>
</tr>
<tr>
<td>Cost of care</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Index hospitalization, USD</td>
<td>36,135</td>
<td>30,283</td>
</tr>
<tr>
<td>Cost per readmission, USD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>15,078</td>
<td>16,287</td>
</tr>
<tr>
<td>2</td>
<td>16,655</td>
<td>17,081</td>
</tr>
<tr>
<td>3</td>
<td>19,500</td>
<td>61,849</td>
</tr>
<tr>
<td>4</td>
<td>15,461</td>
<td>43,536</td>
</tr>
<tr>
<td>Out of pocket cost, USD</td>
<td>738</td>
<td>597</td>
</tr>
<tr>
<td>90-day total payment, USD</td>
<td>39,260</td>
<td>30,616</td>
</tr>
</tbody>
</table>

LOS = Length of stay
IQR = Interquartile range
USD = United States dollars
LO 64

COMPARISON OF OUTCOMES IN INVASIVE IPMN (INV-IPMN) AND SPORADIC PANCREATIC DUCTAL ADENOCARCINOMA (PDAC) IN PATIENTS WHO HAVE UNDERGONE PANCREATIC SURGERY. A MATCHED COHORT ANALYSIS OF THE NCDB

E. Tang, J. Grendar, Z. Jutric, L. Wang, S. Chang, P. Hansen, C. Hammill and R. Wolf
Providence Portland Medical Center, Portland, OR, USA

Objective: Controversy exists regarding outcomes of sporadic pancreatic ductal adenocarcinoma (PDAC), and invasive Intraductal Papillary Mucinous Neoplasm (inv-IPMN). We performed an updated analysis using current histologic codes for IPMN.

Methods: The National Cancer Database (NCDB) was queried for cases of resected inv-IPMN and PDAC. Patients treated with neoadjuvant chemo/radiation therapy were excluded. AJCC 7th edition TNM stage was calculated using size, nodal status, and extra-pancreatic extension. Cox regression and Kaplan Meier analysis was performed, stratified by stage. Analysis was performed on unmatched cohorts, and again on cohorts matched by age, gender and Charlson score.

Results: We identified 12083 cases of PDAC, and 461 of inv-IPMN from 2004 to 2011. There were no differences in 30/90-day mortality. PDAC had higher T stage and node positivity. Unadjusted Cox regression analysis showed significant improvement in survival for inv-IPMN at each stage except Stage IIB (HR 0.78). The difference was most pronounced in stage Ib (inv-IPMN vs PDAC: HR 0.34, 95% CI 0.24–0.47). After matching, inv-IPMN continued to have improved survival at all stages. KM analysis with follow-up out to 10 years showed that the survival lines crossed only for Stage IIB, suggesting that over time the survival advantage diminishes.

Conclusion: According to our analysis, inv-IPMN has a survival advantage over sporadic PDAC. This is less pronounced with extracapsular extension, and nodal disease. The largest difference in survival, was seen in stage IB, suggesting size may be less important as a prognostic factor for inv-IPMN. The relatively favourable survival for inv-IPMN may have implications regarding recommendations for adjuvant therapy.

LO 65

FLANGE GASTROENTEROSTOMY IS ASSOCIATED WITH A REDUCTION IN INCIDENCE AND SEVERITY OF DELAYED GASTRIC EMPTYING (DGE) AFTER STANDARD PANCREATEODUODENECTOMY: A PROSPECTIVE COHORT STUDY

A. S. Khan, G. Williams, C. Woolsey, R. Fields, M. Doyle, W. Hawkins and S. Strasberg
Washington University School of Medicine, St. Louis, MO, USA

Objective: DGE is a common serious problem after PD. Flange gastrojejunostomy is a previously described technique that creates an internal flange in a hand sewn gastroenterostomy (JOGS 15:1468, 2011). It appears to result in less postoperative anastomotic swelling. Results of flange gastro-jejunostomy on incidence and severity of DGE after PD are described.

Methods: Data were obtained from a prospective database of PD and its complications in years 2013—2015. Two types of anastomoses after standard PD with antrectomy (SPD) were performed according to surgeon preference SPD with flange gastroenterostomy (F-SPD) or SPD with non-flange gastroenterostomy techniques (NF-SPD). International Study Group (ISG) definition of DGE was used and DGE severity was graded based on ISG grading system and Accordion Severity Grading System.

Results: 215 SPD were performed, 68 (32%) were F-SPD and 147 (68%) were NF-SPD. DGE rates in F-SPD and NF-SPD were 8.8% and 23.1% respectively (p < 0.05). The differences in severity of DGE were even more prominent. 29.4% of DGEs in NF-SPD group were ISG grade C versus 0% in F-SPD and 35.2% of DGEs in NF-SPD group were Accordion level 3 versus 0% in F-SPD. There were no significant difference in age, race, ASA status, BMI, serum albumin levels, pre-existing diabetes mellitus, operative blood loss, rates of vascular reconstruction, or malignancy on pathology. In the same period 47 pylorus sparing PDs were done with a DGE rate of 23.4%.

Conclusion: In this prospective cohort study the flange technique was associated with a marked reduction of the incidence and severity of DGE after PD.

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LO 66
CLINICAL UTILITY OF IMMUNOGLOBULIN-G4 IN THE DIAGNOSIS OF AUTOIMMUNE PANCREATITIS
Memorial Sloan Kettering Cancer Center, New York, NY, USA

Objective: Autoimmune pancreatitis (AIP) is an uncommon benign disease of the pancreas that can mimic pancreatic adenocarcinoma (PDAC). Elevation in the serum immunoglobulin-G4 (IgG4) level has been reported to be a highly specific marker for AIP, distinguishing it from PDAC. Our study objective was to evaluate the clinical utility of IgG4 levels in diagnosing AIP and differentiating AIP from PDAC.

Methods: Patients were retrospectively identified who were evaluated in our hepatobiliary clinics for suspected AIP and had a measured serum IgG4. Patients were divided by normal IgG4 (<135 mg/dL) and elevated IgG4 (≥135 mg/dL). The sensitivity, specificity, PPV, and NPV of IgG4 for diagnosing AIP was assessed.

Results: From April 1997 through December 2015, 298 patients were evaluated. Median age of presentation was 65 years, and 61% were male. Normal IgG4 levels were present in 85% of patients (254/298), and 15% (44/298) had an elevated IgG4. The overall prevalence of AIP was 17% (52/298), and 67% of AIP patients had an elevated IgG4. The sensitivity and specificity of an elevated IgG4 level for diagnosing AIP was 67% and 96%, respectively. However, the positive predictive value was only 80%, including a 10% occurrence of PDAC in patients with an elevated IgG4.

Conclusion: In this study of selected patients who underwent IgG4 testing, 80% of patients with elevated IgG4 had AIP, and 10% of patients with elevated IgG4 had PDAC. The overreliance on IgG4 elevation as a diagnostic marker for AIP may lead to delayed and potentially missed identification of PDAC.

LO 67
IS TARGETED INTRA-ARTERIAL DELIVERY OF GEMCITABINE SAFE AND EFFECTIVE IN TREATMENT OF PATIENTS WITH LOCO-REGIONAL PANCREATIC TUMORS?
Florida Hospital, Tampa, Tampa, FL, USA

Objective: A dose escalation study of Gemcitabine in locally advanced pancreatic cancer (LAPC), using a targeted intra-arterial delivery catheter (RenovoCath®,). Twenty patients at two centers were enrolled with a four-stage dose escalation of Gemcitabine up to 1000 mg/m². Enzyme markers and blood count were monitored to assess for dose-limiting toxicities. Feasibility and safety of repeated intra-arterial treatment sessions were also assessed. Secondary end points were to assess the effect on tumor size by imaging, tumor markers and conversion to resectability.

Results: One hundred and one treatments were administered to 20 patients. Five patients dropped out early (two or less treatments) either due to adverse events (AE), or withdrawing consent. Significant Adverse Event (SAE) and complications were as follows: sepsis (n = 3), vascular dissection (n = 2), grade 3 neutropenia (n = 3), pulmonary toxicity (n = 1). There were no cases of elevated liver or pancreatic enzymes. Of note, all cases of sepsis occurred in patients with biliary stent/drain; peri-treatment with antibiotics prevented sepsis in the later part of the study. We limited our efficacy analysis to the 15 patients who received more than two treatments. Overall, 55% of these patients had reduction in CA 19-9 tumor markers; based on CT imaging, two had tumor progression, two had partial response, and ten showed disease stability (one patient missed final CT). The median survival at 12 months was 63 percent.

Conclusion: Localized and targeted intra-arterial delivery of Gemcitabine appears safe. In patients who can undergo multiple treatments there is evidence of clinical response superior to historical control.

LO 68
THE USE OF NEGATIVE PRESSURE WOUND THERAPY TO PREVENT POST-OPERATIVE SURGICAL SITE INFECTIONS FOLLOWING PANCREATICOUDENECTOMY
Johns Hopkins Hospital, Baltimore, MD, USA

Objective: Rates of superficial surgical site infection (SSI) following pancreatoduodenectomy remain high despite significant investment in process measures aimed at reducing perioperative infectious complications. Following resection for cancer, complications such as SSI impact adjuvant therapy delivery and portend worse survival. The utilization of an incisional negative pressure dressing (iVAC) has been demonstrated to reduce SSI in other high-risk cohorts.

Methods: Following a comprehensive effort to identify patients at high risk for SSI, practice patterns at a single academic center shifted and iVAC use increased. Data regarding SSI were collected in a prospectively maintained database. Individualized patient risk and SSI rate in the cohort receiving iVAC was compared to the cohort receiving standard closure.

Results: In total, 436 patients underwent pancreatoduodenectomy over 21-months. An iVAC was used in 120 patients (27.5%). The overall rate of SSI was 20%. On multivariate analysis, increased risk for SSI was associated with neoadjuvant therapy, preoperative biliary interventions and prior abdominal surgery. Obese patients and patients receiving preoperative biliary intervention were more likely to have an iVAC. Despite this, iVAC use was associated with a decreased rate of SSI (OR 0.45, p < 0.009). In the highest-risk patients, SSI rate was
decreased from 49% in patients without an iVAC to 19% with iVAC use (p = 0.018).

**Conclusion:** The use of an iVAC following pancreaticoduodenectomy is associated with decreased SSI rates. This is particularly true for patients at highest risk. When integrated with prior work, these data suggest iVAC use may improve adjuvant therapy administration for cancer patients with potential long-term oncologic benefit.

### Table 1
Observed and expected rates of SSI stratified by risk category in patients with and without iVAC placement

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>SSI within 30 days of surgery</th>
<th>p-Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Expected</td>
<td>Observed – all patients</td>
</tr>
<tr>
<td>0</td>
<td>0%</td>
<td>29 (13.6%)</td>
</tr>
<tr>
<td>1</td>
<td>32%</td>
<td>29 (19.3%)</td>
</tr>
<tr>
<td>2</td>
<td>64%</td>
<td>29 (40.3%)</td>
</tr>
</tbody>
</table>

*p-Value* Comparison between patients who did or did not receive wound VACs.

*Risk category as defined in prior work [15].