Purpose: To evaluate the indication, approach, safety, and outcomes of percutaneous mesocaval shunt placement

Materials and Methods: Institutional review board-approved retrospective review of the electronic medical records of patients with percutaneous mesocaval shunts was performed from January 2001 through March 2020 (n = 5). Indication for mesocaval shunt placement was refractory variceal hemorrhage in all 5 patients. All patients had extensive portal vein thrombosis (PVT) (1 intrahepatic, 4 extrahepatic) precluding transjugular intrahepatic portosystemic shunt placement. The underlying etiologies for PVT were non-alcoholic cirrhosis, primary sclerosing cholangitis, pancreatic cancer, post-surgical, and during pregnancy of indeterminate etiology. Post-procedurally, patients were followed for up to 10 years with clinical and laboratory assessment as well as CT or MRI imaging. Technical success was defined as placement of a stent from the superior mesenteric vein to the inferior vena cava. Clinical success was defined as cessation of refractory bleeding. Patient demographics, technical approach for placement, pre-procedural and post-procedural MELD scores, shunt patency, and complications were recorded.

Results: Technical and clinical success was achieved in 100% (5 of 5) of patients. Procedural imaging was available for 4/5 patients. To perform the inferior vena cava to superior mesenteric vein puncture, a combination of fluoroscopy and intravascular ultrasound was used in 25% (1/4), fluoroscopy and transabdominal ultrasonography was used in 25% (1/4), and fluoroscopy and intracardiac echocardiography was used in 50% (2/4). MELD scores (9 – 29) did not significantly deviate from pre-procedure to 30 days post-procedure in any patient. Mesocaval shunt primary unassisted patency was 5/5 (100%) at 6 months, 4/4 (100%) at 12 and 18 months, and 2/3 (67%) at 24 months. After 32 months, one patient underwent intentional mesocaval shunt closure for chronic, refractory hepatic encephalopathy (HE). The final patient maintained mesocaval shunt patency for greater than 10 years. No immediate complications occurred peri-procedurally. Two patients (40%) suffered HE, one of which resolved with medical optimization and the second required eventual shunt closure.

Conclusions: Mesocaval shunt placement is an uncommonly performed procedure to treat complications of portal hypertension when a TIPS cannot be placed. In this cohort, outcomes were comparable to TIPS as it was safe, well tolerated, and remained patent in a majority of patients at 24 months.

Abstract No. 30

Intraarterial administration of a novel metabolic inhibitor enables superior therapeutic efficacy relative to intravenous administration in a translational rodent model of hepatocellular carcinoma

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Purpose: Hepatocellular carcinoma (HCC) is the fastest rising cause of cancer mortality in the United States. We recently established the potential value of lactate dehydrogenase (LDH) inhibition as a therapy for HCC, further highlighting this disease’s enhanced relative dependence on LDH for growth and survival. Recognizing the importance of optimizing drug delivery, we hypothesized that local delivery of this metabolic inhibitor would enhance its therapeutic efficacy. By comparing the effects of intravenous and intraarterial delivery of an LDH inhibitor, the purpose of this study was to examine whether local delivery would enhance therapeutic efficacy.

Materials and Methods: Diethylamino-3-phenyl-1,2,4-triazole-5-sulfonamide (0.01%) was supplemented to the drinking water of male Wistar rats for 12 weeks to induce autochthonous HCC formation. Animals with tumors measuring 100 mm³ on T2-weighted MRI received a single dose of an LDH inhibitor (10 mg/kg; 737 – NCI) either intravenously (n = 6) or intraarterially (n = 7). Treatment efficacy was compared in the two groups according to the change in tumor growth rate, which was quantified using an exponential growth model fit to tumor measurements taken before and after drug administration. This model is summarized by the formula: Volume = Sizec = 0*(A)^t. The fold-change in the model parameter A was used as a test statistic (TS) for all comparisons reported.

Results: Intraarterial delivery of LDH inhibitor significantly slowed tumor growth (TSavg = 0.989, TSed = 0.00761, P<0.01). Consistent with prior reports, intravenous LDH inhibitor delivery also slowed tumor growth (TSavg = 0.997, TSed = 0.00210, P<0.05). The therapeutic effect of intraarterial delivery was statistically superior to that observed with intravenous delivery (P<0.05). Of note, tumor regression was observed in 3 of 7 animals in the intraarterial group, while this was never observed in the intravenous group.

Conclusions: These data demonstrate the superiority of intraarterial delivery for an LDH inhibitor previously shown to slow tumor growth in a rodent model of HCC. Future work will examine the potential synergistic effects of multiple injections and/or use of embolics on treatment response. More broadly, these findings highlight the benefit of locoregional administration of cancer therapies by interventional radiologists as a means of improving therapeutic efficacy.

Abstract No. 31

Combined thermal ablation with adjuvant liposomal granulocyte-macrophage colony-stimulating factor (lip-GM-CSF) increases periblational immune cell trafficking in a small animal tumor model

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Purpose: To augment intratumoral immune cell trafficking following thermal tumor ablation using adjuvant systemic liposomal GM-CSF

Materials and Methods: Subcutaneous R3220 rat breast adenocarcinoma tumors implanted in Fisher rats (total n = 72 tumors, treated at 11-13 mm diameter) were randomly assigned to 6 groups: a) sham; b, c) liposomal or free GM-CSF (1.4 μg/mL) alone; and d, e, f) RF alone (21 g 1 cm active tip electrode, 5 min at 70°C), and in combination with liposomal GM-CSF or blank liposomes. Animals were sacrificed at 3 and 7 days post-RFA.
Outcome measures included gross tissue coagulation, tumor growth and immunohistochemical characterization (cell positivity/ high power field) of markers of dendritic cells (DCs) (CD11c), M1 macrophages (CD68), and cytotoxic T-cells (CD8+) in the periablational rim and in untreated tumor two high power fields away from the ablation zone.

**Results:** Adjunctive lip-GM-CSF with RFA markedly increased periablational CD8+ cell infiltration at 3d and 7d (113.3 ± 39.3 vs RFA: 59.3 ± 11.1 cells/hpf; and 218.4 ± 20.5 vs RFA: 38.5 ± 15.5, respectively), and M1 cells at 7d (123.3 ± 44.5 vs RFA: 59.9 ± 16.5) (P< 0.05, all comparisons). Additionally, RFA/lip-GM-CSF markedly increased intratumoral M1 cells early at 3d (297.4 ± 35.5 vs RFA: 195.5 ± 20.1) and DCs (51.6 ± 40.2 vs RFA: 8.9 ± 11.1) and CD8+ cell trafficking later at 7d (123.9 ± 55.6 vs RFA: 63.5 ± 27.6) (P< 0.05, all group comparisons) in untreated tumor. No statistically significant differences were observed in overall coagulation or tumor growth at 3d and 7d (P>0.05, all comparisons).

**Conclusions:** Adjunctive systemic liposomal GM-CSF administered at the time of RF ablation combined with nanoparticle-based GM-CSF results in significantly increased periablational and overall tumor immune cellular trafficking, specifically cell populations associated with initiating anti-tumor immunity.

**Clinical relevance:** Liposomal immunomodulating preparations can potentially improve RFA-induced anti-tumor immunity over conventional thermal modalities, further refining the combined ablation / nanodrug paradigm.

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**Materials and Methods:** 40 patients with PNLM who underwent CT scans and biopsies at a single center from April 2009 to February 2018 were included in the database. Biopsied tumors with recorded tumor grade (Grade 1-3) and mutation status (presence or absence of MEN1/DAXX/ATRX mutation) were segmented in both the hepatic arterial (HAP) and portal venous (PV) phases using 3D Slicer. Quantitative features (n = 115) from each scan were extracted from segmented tumors using PyRadiomics. Standard feature normalization was performed. Principal component analysis (PCA) was used for dimensionality reduction. Linear and radial basis function support vector machine (SVM) were used for training. K-fold cross-validation was used to estimate testing accuracy. Permutation testing was used to assess statistical significance.

**Results:** There were 25/40 (62.5%) patients with MEN1, DAXX, and/or ATRX mutation. There were 9/40 (22.5%) G1 tumors, 16/40 (40%) G2 tumors, and 37.5% G3 tumors. Over 95% of the variance in the data was described by the top 6 principal components, which were used for training and testing. Testing accuracy was 75% ± 11% for predicting mutation status (P = 0.008). Testing accuracy was 52.5% ± 11% for predicting tumor grade (P = 0.004).

**Conclusions:** CT radiomic features can be used to predict mutation status and tumor grade in patients with PNLM.

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**Safety and efficacy of transarterial radioembolization after prior transarterial chemoembolization**

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**Purpose:** Transarterial radioembolization (TARE) is a common technique to treat patients with hepatocellular carcinoma refractory to transarterial chemoembolization (TACE). TARE can cause liver toxicity. The degree of toxicity may be heightened due to previous liver injury from prior endovascular therapies. This study assessed the safety and changes in liver function after TARE for multifocal hepatocellular carcinoma refractory to previous embolization.

**Materials and Methods:** Retrospective chart review was performed between 2017 and 2019 to identify patients who underwent TACE or bland embolization followed by TARE for hepatocellular carcinoma. Demographic, laboratory, and imaging information was collected prior to TARE and 3, 6, 9, 12, 18, and 24 months after TARE (if available).

**Results:** 30 patients were included. Mean age was 67.5 years (53-89), 10 were females. There was a median of 2 prior lesion specific treatments for each patient. The mean prescribed Y90 activity per was 2.6 Gbq. Thirteen patients died. Median overall survival had not been met with a median follow-up of 22.4 months from the time of TARE. There was a significant increase in INR from before (1.2) to 6 months (1.6) (P = 0.012), MELD score from before (9.8) to 6 months (14.1) (P = 0.021), and in Child-Pugh score from before (6.2) to 3 months (7.2) (P = 0.0002), 6 months (8.1) (P = 0.003), and 9 months (7.5) (P = 0.03) after treatment. There was also worsening in ALBI score from before (-2.3) to 3 months...