IRB-approved prospective, observational study after giving informed consent. Patients completed the Brief Pain Inventory (BPI) prior to ablation and 6-months post-ablation. Differences in pain severity and interference outcomes on a 0- to 10-point scale (higher number meaning greater severity or interference) were compared using a paired t-test.

**Results:** 14 patients (12 female, 2 male; mean age, 32.1 years) underwent 21 US/MRI-guided and monitored ablation sessions including laser (n = 18) and cryoablation (n = 3) for treatment of painful slow flow venous (n = 12) or venolymphatic (n = 1) malformations or hemangioma (n = 1) located in the lower extremity (n = 9), upper extremity (n = 4) and face (n = 1). Nine patients (64%) had undergone prior VA therapy including percutaneous sclerotherapy (89%) and/or surgery (44%). Median maximal VA diameter was 5.7 cm (range 1.6 to 28.6 cm). Post-ablation 3 patients were discharged same day (14%) and 18 after overnight observation (86%) Mean (±SD) pre-ablation worst pain was 8.0 ± 1.4 and average pain 5.4 ± 1.3 with a significant decrease in worst pain -4.8 ± 3.5 (P < 0.001) and average pain -3.3 ± 2.4 (P < 0.001) at 6-month post-ablation. Mean (±SD) pre-ablation pain interference severity was as follows: general activity — 5.9 ± 2.5, mood — 4.7 ± 2.2, walking ability — 5.4 ± 3.9, work — 6.4 ± 2.8, sleep — 5.8 ± 2.8 and enjoyment of life — 6.0 ± 3.1. There was a significant improvement in all pain interference outcomes at 6-months post-ablation: general activity -3.9 ± 3.0 (P < 0.001), mood -2.5 ± 3.0 (P = 0.010), walking ability -3.8 ± 4.1 (P = 0.006), work -4.5 ± 3.2 (P < 0.001), sleep -3.7 ± 3.0 (P < 0.001) and enjoyment of life -4.1 ± 3.3 (P < 0.001). There were no major and 2 minor ablation related complications.

**Conclusions:** These 6-month interim data suggest that MRI-guided laser ablation and cryoablation are safe and provide early significant improvements in pain severity and pain interference outcomes in patients with focal painful peripheral soft tissue vascular anomalies. Ongoing serial follow-up in this cohort will help to establish longer term outcomes.

**Abstract No. 18**

**Radiofrequency ablation in conjunction with vertebral augmentation for the treatment of spine metastases**

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**Purpose:** To evaluate the safety and efficacy of radiofrequency ablation and cement augmentation for the treatment of secondary metastases to the spine

**Materials and Methods:** This single-institution retrospective study evaluated the treatment of 332 lesions in 165 patients (94 men, mean age 64 years) over a 2-year period (2017 – 2019). Percutaneous radiofrequency ablation (RFA) and cement augmentation was performed under fluoroscopic or computed tomography guidance; kyphoplasty versus vertebroplasty was performed at the discretion of the provider. Treated levels included upper thoracic (39/332), lower thoracic (121/332), and lumbar (172/332) vertebral bodies.

**Results:** The majority of treated levels (262/322, 81%) resulted in a substantial improvement in pain (> 2-point reduction in Brief Pain Inventory scale following the procedure). Based on univariable and multivariable analysis, significant predictors of treatment failure included cancer type (melanoma, hematologic malignancies; P < 0.001), age > 70 years (P = 0.03), and interventional imaging modality (fluoroscopy, P = 0.01). Cement leakage occurred in 19% (61/322) of treated levels, though leakage was asymptomatic in all but 1 patient; posterior vertebral body wall erosion due to tumor was present in 19% (62/322) of treated levels and was not associated with leakage. However, use of RFA was significantly associated with a decreased rate of leakage (P = 0.003). No patients experienced spinal cord or spinal nerve injury following RFA.

**Conclusions:** Radiofrequency ablation and cement augmentation is a safe and effective treatment for painful spinal metastasis.

**Scientific Session 4**

**Ablations**

**Tuesday, March 23, 2021**

**Abstract No. 19**

**Optimal timing of cytotoxic chemotherapy when combined with thermal ablation of liver metastases**

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**Purpose:** Adjuvant versus neoadjuvant chemotherapy has been extensively discussed in the surgical literature, but much less is known about the optimal timing of peri-ablation chemotherapy. Here, we examine whether the timing of peri-ablation chemotherapy (adjuvant versus neoadjuvant) affects outcomes.

**Materials and Methods:** From 2013 to 2019, 651 percutaneous liver ablation procedures were performed in 501 patients. Of these, 96 patients had cytotoxic chemotherapy within 30 days of the patient’s initial thermal ablation of liver metastases. 26 patients had chemotherapy within 30 days after ablation (adjuvant group); 17 patients had chemotherapy within 30 days before ablation (neoadjuvant group); and 53 patients had both adjuvant and neoadjuvant chemotherapy (within 30 days of ablation). In addition, almost all patients (91 of 96; 95%) received chemotherapy more than 30 days before liver ablation. Clinical variables, including histology, size and number of ablated metastases, extrahepatic disease, prior therapies, laboratory values, and KRAS mutations, were also analyzed. Overall survival, and time to local and distant progression, were analyzed using Kaplan Meier, log rank test, and Cox proportional hazards model.

**Results:** Median overall survival after initial liver ablation was 56 months in the adjuvant group, 43 months in the neoadjuvant group, and 26 months in the adjuvant plus neoadjuvant group (P = 0.03). Multivariate analysis, including clinical variables, showed that neoadjuvant chemotherapy was associated with worse overall survival.
(RR = 5.9, P< 0.001), but no difference in time to local or distant progression. Patients who received chemotherapy within 30 days before ablation had slightly lower albumin (4.1 ± 0.3 versus 4.3 ± 0.4), but otherwise, the timing of peri-ablation chemotherapy was not associated with any differences in size or number of ablated metastases, extrahepatic disease, histology, prior therapies, or other characteristics. Number of liver metastases ablated, presence of unablated liver metastases, and low albumin were associated with worse survival. Prior liver resection was associated with better survival. **Conclusions:** Among patients who received peri-ablation chemotherapy, cytotoxic chemotherapy within 30 days after therapy was associated with the highest overall survival. The etiology of this association is unknown, and further studies are required.

**Abstract No. 20**

Assessment of pre-emptive multimodal analgesia to reduce post-procedural opioid requirements in patients undergoing liver microwave ablation

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**Purpose:** Microwave ablation (MWA) of liver tumors is associated with post-ablation pain in up to 30% of patients. In the surgery and anesthesia literature, protocols of enhanced recovery after surgery (ERAS) have been studied and applied clinically. Central to the ERAS protocols is multimodal pre-emptive analgesia, with the goal of decreasing opioid consumption and post-operative pain, while increasing patient safety and satisfaction. This study evaluated the effect and safety of an evidence-based pre-emptive multimodal analgesic regimen in reducing total opioid requirements in patients undergoing liver MWA.

**Materials and Methods:** This is a single-center retrospective review of 207 patients (M:F = 142:65, mean age = 66 ± 9.9 years) who underwent 244 image-guided percutaneous liver MWA consecutively between January 2017 and December 2019. Cases with pre-procedural multimodal analgesia (PPMA) (191 procedures) were compared to cases without PPMA (53 procedures). PPMA included premedication with ≥1 analgesic (acetaminophen, celecoxib, gabapentin, tramadol, or topical lidocaine patch). The primary outcomes measured were total opioid utilization (intra-procedural and post-procedural) reported in morphine milligram equivalents (MME), patient reported pain via a visual analog scale (VAS), and post-procedural respiratory events (PPRE) defined as any airway rescue maneuver for hypoxia (SpO2 < 90%).

**Results:** Within the PPMA group, postoperative MME (3.97mg vs 8.70mg, P = 0.02) and visual analog pain score at > 120 min post-procedurally (2.05 vs 3.12, P = 0.03) was significantly reduced. There was no difference in hospital admissions (23% vs 21%, P = 0.74), post procedure ketorolac (8.11mg vs 7.64mg, P = 0.80), or post procedure tramadol (6.12mg vs 2.83mg, P = 0.27). There were no PPRE events recorded.

**Conclusions:** In patients undergoing liver MWA for hepatic neoplasms, administration of PPMA was safe and resulted in less total opioid utilization and lower patient-reported pain. Utilization of PPMA for MWA of liver tumors can significantly reduce patient pain post-procedurally and decrease the amount of opioid medications prescribed.

**Abstract No. 21**

A multi-institutional investigation of image-guided percutaneous ablation for intrahepatic cholangiocarcinoma: outcomes analysis and impact of molecular profiling

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**Purpose:** To evaluate characteristics, including tumor molecular profiling, and outcomes of patients with intrahepatic cholangiocarcinoma (ICC) submitted to percutaneous ablation (PA)

**Materials and Methods:** This is a three-institution retrospective analysis of 46 patients (28 males) with a total of 69 ICCs (local therapy treatment-naïve at target ICC: 53) submitted to PA (Radiofrequency ablation = 25; Microwave ablation = 39; Irreversible electroporation = 5 ICCs) between 2007 and 2019. Indications included unresectable (12 patients; 15 ICCs), post-irradiation (5 patients; 5 ICCs), and post-resection recurrence (29 patients; 49 ICCs). Median tumor diameter was 1.6 cm (range, 0.5-5.1 cm). Outcomes evaluated included local tumor progression-free survival (LTPFS), intra-hepatic progression-free survival (IHPFS), overall survival (OS), and major complications. Recent molecular profiling studies indicate a distinct pattern of somatic mutations in ICC; we explored the impact of these mutations on the clinical outcomes from PA.

**Results:** 42 patients with a total of 65 ICCs had imaging follow-up (mean 25.7 months, range 0.7-93.6). Primary technical efficacy was 92%. Three-year LTPFS was 71.5%, mean IHPFS was 15.6 months, and mean OS was 47.1 months for the entire cohort. One major complication (liver abscess) occurred, with no deaths recorded. Somatic mutations were present in 13 (72%) of the 18 patients who received molecular profiling, 6 patients (33%) with a total of 9 ICCs, which possess poor-prognosis mutations (CDKN2A = 3; ARID1A = 2; MSH2 = 1). Three-year LTPFS, mean IHPFS, and mean OS for patients with poor-prognosis mutations were 66.7%, 9.8 months, and 23.8 months, respectively.

**Conclusions:** PA is an effective loco-regional therapy for small-localized ICC. Larger cohort studies are warranted to evaluate the association between mutational profile and efficacy of liver-directed therapies.

**Abstract No. 22**

Predictors of intrahepatic recurrence of hepatocellular carcinoma following percutaneous microwave ablation of tumors larger than 3 cm

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**Purpose:** To identify the predictors of local recurrence and distant intrahepatic recurrence following microwave ablation of hepatocellular cancer larger than 3 cm