Non-resectable and metastatic tumors present a difficult challenge for veterinarians and pet owners. The relatively limited efficacy of intravenous chemotherapy for macroscopic disease, and the cost, morbidity, and tumor resistance associated with radiation therapy have stimulated the search for additional therapeutic options. Similar difficulties in human oncology have inspired various creative, image-guided, regional tumor therapies in the continuously developing subspecialty of interventional radiology (IR). IR involves the use of contemporary imaging techniques such as fluoroscopy and ultrasonography to selectively access vessels and other structures in order to deliver different materials for therapeutic reasons. In the past two decades, IR techniques have expanded considerably with both vascular and non-vascular procedures being performed routinely in humans. Specifically, IR techniques are being increasingly utilized to help palliate humans with cancer (interventional oncology) in which traditional therapies have failed or have been demonstrated to provide little benefit. These techniques are particularly useful in cases of regional disease in order to maximize local therapy and minimize systemic toxicity.

While results have been variable, regional techniques such as percutaneous tumor ablation, intra-arterial chemotherapy, transcatheter arterial embolization/chemoembolization, and/or palliative stenting have been demonstrated to improve survival times, disease-free intervals, recurrence rates, or completeness of tumor necrosis (Additional references available from author upon request). Last year a similar talk focused on procedural examples; this year there will be a focus on scientific results, both human and early veterinary studies.

Palliative Stenting for Malignant Obstructions

Animals are routinely euthanized for local effects of a tumor rather than the systemic effects associated with a large cancer burden. For example, malignant obstructions of the urinary tract associated with transitional cell carcinomas or prostatic tumors can result in life-threatening signs associated with complete urinary tract obstruction. IR techniques involving the placement of intra-luminal stents to palliate similar malignant obstructions in humans have been described. These IR techniques were rapid, safe, minimally-invasive, and effective, and complications were minor and uncommon. More recently additional results have been published demonstrating improved results than previously for urethral stenting. Larger case series with animals receiving chemotherapy and NSAIDs have resulted in prolonged survival times and low morbidity. Considering the reported UGELAB complications, cost, hospitalization times, need for repeat procedures, possible limitation to females, and otherwise similar outcomes, stenting appears to compare favorably. This technique is currently being performed at most of the major oncology centers around the country and appears to be the favored technique for management of malignant urethral obstructions in dogs. At this conference, an abstract will be presented in poster form.
that demonstrates similar positive outcomes with low morbidity and similar incontinence rates when performed in cats for benign or malignant urethral obstructions.\(^4\)

**Intra-Arterial Chemotherapy Delivery**

Current therapies for bulky tumors not amenable to complete surgical include chemotherapy, radiation therapy, and surgical debulking, but none are able to consistently produce durable remissions. Research suggests that some of these tumors can respond more favorably to higher concentrations of chemotherapy, however significant deleterious side effects often result when dose escalations are attempted. Recent advancements in interventional radiology techniques now enable veterinarians to administer different drugs into the arteries feeding the actual tumors via minimally-invasive approaches in order to achieve very high regional drug concentrations within the tumor without the systemic side effects that would occur had these levels been administered intravenously. This basically provides a local dose escalation without the increased systemic toxicities. Studies confirm both higher achieved levels of chemotherapy within the targeted tissues as well as improved tumor remissions in laboratory animals. Recently published date supports improved tumor response rates when performed for urothelial carcinomas in female dogs as male dogs had poor outcomes.\(^5\)

**Arterial Embolization / Chemoembolization**

Chemoembolization involves super-selective intra-arterial chemotherapy delivery in conjunction with subsequent particle embolization. Intra-arterial chemotherapy has been shown to result in a 10- to 50-fold increase in intra-tumoral drug concentrations when compared to systemic intravenous chemotherapy administration.\(^6\) Subsequent particle embolization results in tumor cell necrosis and paralyzes tumor cell excretion of chemotherapy resulting in minimized systemic toxicity. This procedure is most commonly used in the treatment of diffuse hepatocellular carcinoma or metastatic liver disease in humans. Most hepatic tumors depend upon hepatic arterial blood supply (up to 95%) for growth in contrast to the normal liver parenchyma that receives the majority of its blood supply via the portal vein (only ~20% from the hepatic artery).\(^7\) Hepatic artery embolization should theoretically cause more ischemia to the liver tumor while the remaining normal hepatic parenchyma obtains sufficient oxygenation from the portal venous system. More recently, chemotherapy-eluting beads are being evaluated in veterinary patients with nonresectable liver tumors (Figure 2). Reported complications in the human literature include hemorrhage at the vascular access site, non-target embolization complications (skin necrosis, damage to normal parenchyma), hepatic infarction/abscessation, acute renal failure (for liver tumors), and post-embolization syndrome, a collection of clinical signs characterized by malaise, fever, and pain.\(^8\) The author’s experience with HCC chemoembolization suggests similar risks in veterinary patients as well as reduced systemic exposure to chemotherapy, minimal morbidity, and improved tumor response rates when compared to systemic chemotherapy.
**Percutaneous Tumor Ablation**

Percutaneous tumor ablation techniques (radiofrequency ablation as well as microwave ablation, laser thermal ablation, cryoablation (Figure 3), and percutaneous ethanol injection) tend to be most effective with a few (<3), small (<4cm diameter) lesions. These circumstances are fairly uncommon in the author’s clinical experience, however with the routine use of more advanced imaging techniques in veterinary medicine, lesions of this size and number may become increasingly apparent during tumor re-staging procedures, making tumor ablation techniques a reasonable option in the future. More recently, advances in local ablation technology have provided the ability to more closely monitor the areas of ablation as well as to provide larger ablation areas. The author has been investigating the use of cryotherapy for advanced tumors of the head and smaller difficult-to-resect liver tumors.9 Recent evidence suggests potential systemic benefits from the use of local ablative therapies.

**References**