Percutaneous Microwave Ablation with a High-Powered, Gas-Cooled Antenna: Initial Clinical Experience


Introduction

Microwave ablation is a promising technology which offers distinct advantages over other ablation modalities given decreased effect of charring, greater depth of penetration, and continuous energy deposition. Adoption of microwave ablation has been limited due to concerns over heating with higher powers and resultant large lesion diameters with liquid cooled systems. A high-powered, gas-cooled microwave system which has previously shown advantages over other ablation modalities given decreased effects to desiccation of the tissue. Adoption of microwave ablation has been limited due to concerns over heating with higher powers and resultant large lesion diameters with liquid cooled systems. A high-powered, gas-cooled microwave system which has previously shown advantages over other ablation modalities given decreased effects to desiccation of the tissue.

Clinical Results

All ablations were considered technically successful at the time of examination. One month follow-up CT was available for 8 of the initial lesions demonstrating absence of residual disease. A patient with hepatocellular carcinoma underwent hepatectomy following percutaneous microwave ablation, with surgical pathology demonstrating complete cellular death of the tumor. There was one minor complication (pneumothorax requiring thoracentesis) in one week post procedure and no major complications. Average ablation time was 6.4 minutes (range 2-15 minutes). Ablation zone for a single antenna averaged 4.6 cm in length (range 3.0-6.5 cm) and 4.3 cm in width (range 2.0-3.9 cm) utilizing antenna powers ranging from 50-140 Watts. Ablation zone for two antennae averaged 5.6 cm in length (range 4.1-6.6 cm) and 4.3 cm in width (range 3.2-5.2 cm) utilizing antenna powers ranging from 50-140 Watts. The largest ablation zone achieved was 9.2 x 7.7 x 6.0 cm utilizing 3 antennae concurrently at a power of 60 Watts with an ablation time of 8 minutes.

Ablation Times

CT images of percutaneous demonstrating a 2.3 x 2.0 x 2.3 cm metastatic colorectal cancer (red arrows) and (b) post-procedure contrast enhanced demonstrating complete absence of contrast in the ablation zone (blue arrow). Ablation performed with single antenna at initial power of 100 Watts with resultant ablation zone of 4.6 x 3.2 x 3.0 cm. Ablation performed with a single antenna at initial power of 70 Watts which was increased to 90 Watts during a 6 minute ablation. Resultant ablation zone of 4.2 x 3.0 x 2.6 cm.

Case Example- Renal Cell Carcinoma

CT images of percutaneous demonstrating a 2.5 x 2.7 x 2.5 cm right sided renal cell carcinoma (red arrow) and (b) post-procedure contrast enhanced demonstrating complete absence of contrast in the ablation zone (blue arrow). Ablation performed with single antenna at initial power of 95 Watts with resultant ablation zone of 4.6 x 3.2 x 3.0 cm. Ablation performed with a single antenna at initial power of 70 Watts which was increased to 90 Watts during a 6 minute ablation. Resultant ablation zone of 4.2 x 3.0 x 2.6 cm.

Case Example- Hepatocellular Carcinoma

CT images of percutaneous demonstrating a 2.3 x 2.1 x 2.0 cm stellate hepatic hemangioma (red arrow). (c) US image of an antenna within the mass prior to ablation, (d) US image of the hepatic segment with gas encompassed with a zone of ablation (green arrow). Patient underwent hepatectomy demonstrating ablation zone of 4.1 x 3.0 x 2.1 cm. Ablation performed with single antenna at initial power of 100 Watts with resultant ablation zone of 4.9 x 3.6 x 2.1 cm.

Case Example- Metastatic Colorectal Cancer

Patient with hepatic and retroperitoneal metastases, a symptomatic hepatic hemangioma, a renal angiomyolipoma, a renal cell carcinoma, and metastatic colorectal cancer. (c) US image of an antenna within the mass prior to ablation, (d) US image of the hepatic segment with gas encompassed with a zone of ablation (green arrow). Patient underwent hepatectomy demonstrating ablation zone of 4.1 x 3.0 x 2.1 cm. Ablation performed with single antenna at initial power of 100 Watts with resultant ablation zone of 4.9 x 3.6 x 2.1 cm.

Case Example- Metastatic Colorectal Cancer

CT images of percutaneous demonstrating a 2.3 x 2.1 x 2.0 cm metastatic colorectal cancer (red arrow). (c) US image of an antenna within the mass prior to ablation, (d) US image of the hepatic segment with gas encompassed with a zone of ablation (green arrow). Patient underwent hepatectomy demonstrating ablation zone of 4.1 x 3.0 x 2.1 cm. Ablation performed with single antenna at initial power of 100 Watts with resultant ablation zone of 4.9 x 3.6 x 2.1 cm.

Case Example- Leiomyosarcoma Metastasis

Patient with metastatic colorectal cancer. (a) US image of an antenna within the mass prior to ablation, (b) US image of the hepatic segment with gas encompassed with a zone of ablation (green arrow). Patient underwent hepatectomy demonstrating ablation zone of 4.1 x 3.0 x 2.1 cm. Ablation performed with single antenna at initial power of 100 Watts with resultant ablation zone of 4.9 x 3.6 x 2.1 cm.

Case Example- Metastatic Colorectal Cancer

CT images of percutaneous demonstrating a 2.3 x 2.1 x 2.0 cm metastatic colorectal cancer (red arrow). (c) US image of an antenna within the mass prior to ablation, (d) US image of the hepatic segment with gas encompassed with a zone of ablation (green arrow). Patient underwent hepatectomy demonstrating ablation zone of 4.1 x 3.0 x 2.1 cm. Ablation performed with single antenna at initial power of 100 Watts with resultant ablation zone of 4.9 x 3.6 x 2.1 cm.

Conclusion

Percutaneous microwave ablation utilizing a high-powered gas-cooled antenna is showing promise as a safe and effective alternative treatment modality which may allow fewer needle punctures with a shorter ablation time. Continued clinical use with longer follow-up is warranted to confirm these initial findings.