

Appendix 1 Methods

Imaging acquisition parameters

Cone beam computed tomography images were acquired with a 40 cm × 40 cm flat-panel detector angiosuite (Innova 4100, GE Healthcare, IL, USA); 244 projections were obtained through a 200° rotation at 10°/s (for planning and ablation zone assessment) and 20°/s (for probe position confirmation). Computed tomography images were all acquired in supine position with breath hold (LightSpeed RT16, GE Healthcare, IL). Acquisition parameters were: tube voltage, 120 kV; tube current, 440 mA; slice thickness, 0.625 mm; pitch, 1.375:1; matrix, 520×520. Contrast enhanced images were obtained 35–45 s, 90 s, and 180 s after intravenous injection of 80–100 mL of Iohexol (Omnipaque 300, GE Healthcare, Milwaukee) at a 2.5 mL/s rate (25).

NEUWAVE FLEX microwave ablation system description

The NEUWAVE FLEX System is a fully featured soft tissue ablation system that uses small diameter flexible ablation probes, a single microwave source with a 100 W microwave power amplifier operating at 2.45 GHz, a CO₂ based cooling system, and a Power Distribution Module (PDM). Microwave energy is applied to the target tissue, heating the tissue to the point of necrosis.

One, easy to use, touch-screen user interface controls the system. Microwave energy is delivered through one distinct channel to the ablation probe. The CO₂ cooling system helps limit the temperature of the probe cable. The PDM is designed to have a highly efficient large cable from the PDM to the power amplifier, which allows for more energy delivery to the ablation probe.

Two flexible ablation probe types are available for use with the NEUWAVE FLEX System: the FLEX4 and the FLEX6. The probe types have different tips to aid in tissue access. The model number indicates the sharpness of the tip: the higher the number, the sharper the tip. FLEX probe models are French gauge 6 (outer diameter of less than 2 mm). Each ablation probe contains temperature measurement sensors that help monitor performance and ensure patient and operator safety.

The NEUWAVE FLEX System has several safety features which monitor system performance. The system will automatically stop delivering energy to the patient in response to system performance issues.

Pathology analysis

Pigs were euthanized with an intravenous injection of pentobarbital sodium (87 mg/kg) and phenytoin sodium (11 mg/kg) at the following survival timepoints: immediately, 24–48 h, 7–8 days, 13–15 days, and 19 days after microwave ablation. Following euthanasia, the lungs and trachea were removed *en bloc*. The lungs were filled through an endotracheal tube with 10% neutral buffered formalin at a pressure of 20 cm of water and were distended to their approximate in vivo inspiratory volume (26). They were immersed in formalin for 48–72 h then entirely sectioned at 5–7 mm intervals in the axial plane. Photographs of gross sections with a measurement reference were obtained. All slices with a visible ablation zone were processed in alcohol and xylene, embedded in paraffin, sectioned at 5 micro thickness, stained with hematoxylin and eosin and were reviewed by a board-certified veterinary pathologist. Since the target material could not be visualized on gross or histologic examination following the first pig's examination, gross slices from the subsequent pigs that had a visible ablation zone on gross analysis were radiographed using a digital Faxitron MX20 Specimen Radiography System (Qados, Cross Technologies plc, Berkshire, UK). Radiographies of gross slices were rescaled and overlaid on corresponding gross slices photos, and minimal and maximal ablation margins were measured on the merged photos using image J software (43).

References

43. Schneider CA, Rasband WS, Eliceiri KW. NIH Image to ImageJ: 25 years of image analysis. *Nat Methods* 2012;9:671-5.

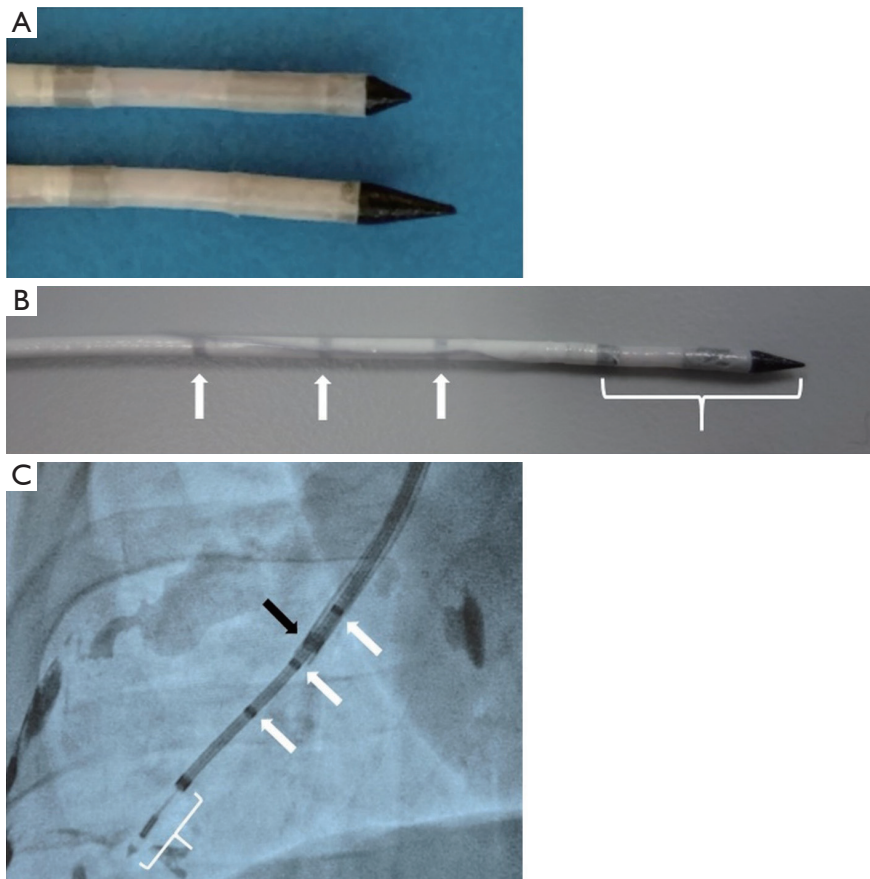


Figure S1 FLEX probe and system presentation (photos and technical details). Images of the FLEX ablation probe showing the conical tip geometries (A) of the FLEX4 (top, A) and FLEX6 (bottom, A) and some key probe features (B) including antenna section (white brace) and distal end marker bands (white arrows) at 3, 4, and 5 cm from the tip. These features are visible in two-dimensional X-ray imaging (C) of the FLEX Probe (white arrows) as seen deployed through the steerable sheath (Destino Twist, Oscor Inc., FL, USA) (black arrow).