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Initial evaluation of Cyberknife technology for extracorporeal renal tissue ablation.

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OBJECTIVES: To determine whether Cyberknife technology can be applied to renal tissue safely and effectively. The goal was to achieve the high efficacy of a surgical treatment, with the low morbidity of a noninvasive intervention.

METHODS: The Cyberknife is a frameless, image-guided radiosurgical device. This innovative extracorporeal treatment combines a linear accelerator mounted on a highly maneuverable robotic arm. The Cyberknife is unique in that it divides the high-dose radiation necessary to ablate the lesion completely into up to 1200 beams. Each one of these beams of radiation has a significantly reduced dose. Therefore, the individual dose of each beam is essentially benign to the pathway and surrounding tissue. However, at the focal point of these beams, the dose is additive, and the desired ablative dose is attained. Predetermined "lesions" in 16 kidneys were treated in vivo in the porcine model. Complete treatment was accomplished in one session per animal, with no complications. Gross and histologic evaluations were completed at 4, 6, or 8 weeks.

RESULTS: The degree of radiation changes correlated with longer treatment intervals. After 8 weeks, the lesions showed complete fibrosis. The zones of complete fibrosis were characterized by dense, paucicellular connective tissue completely devoid of all normal kidney elements, including tubules and glomeruli.

CONCLUSIONS: This initial preclinical evaluation of the Cyberknife for extracorporeal renal tissue ablation appears to be very promising and demonstrated its ability to ablate a targeted area precisely and completely with relative sparing of the surrounding tissue. This innovative technology introduces an exciting approach as a potential treatment option of renal masses in the future.

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