Dynamic Contrast Enhanced Imaging After Canine Prostate Cryoablation

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Introduction

MR-guided cryoablation is a promising minimally invasive therapy for prostate tumors that are solitary and unilateral.[1] The roles of imaging are targetting, monitoring, and post-therapy evaluation. It has been shown that contrast enhanced imaging provides a beautiful depiction of the vascular damage in the cryolesion.[2] The purpose of this work was to evaluate previously frozen prostate tissue with dynamic contrast enhanced imaging and 3D contrast enhanced imaging.

Methods

Three dogs were imaged with a phased array coil setup including an endorectal coil and an anterior surface coil in a 0.5T GE Signal MRI scanner. Two MR-compatible cryoprobes (Oncura, Israel) were placed through the anterior abdominal wall to locations on either side of the prostate. In each dog, one cryoprobe was frozen only once, while the other completed two freeze-thaw cycles. T1-weighted FSE images were obtained at the height of each freeze to delineate the iceball sizes. After complete thaw to normal body temperature, dynamic 2D SPGR images (1.9 s/image) were acquired and repeated during the injection of a gadolinium contrast agent. CE 3D SPGR images were immediately acquired. The dogs were euthanized and sliced prostate samples were incubated in a 1% triphenyl tetrazolium chloride (TTC) solution.

Results

In all experiments, the normal prostate tissue enhanced. In the core of the cryolesion, the tissue did not enhance. An example set of images is shown in Figure 1. In all three experiments, there was a rim of hyperenhancement. Plots of the signal intensity on the dynamic contrast enhanced images in two experiments are provided in Figure 2. By comparison with TTC stained sections, the rim appears to lie within the normal pink staining tissue. The border of the hyperenhancing rim seemed to correspond well to the border between the hemorrhagic core of the cryolesion and the normal pink staining tissue on TTC. The size of the hyperenhancing rim varied in thickness from one experiment to another, varied in thickness from one lesion to another in the same experiment, and even varied in thickness within the same cryolesion. These variations can be seen in the images shown in Figure 3. The time course of enhancement on the rims were also variable, as shown in Figure 2.

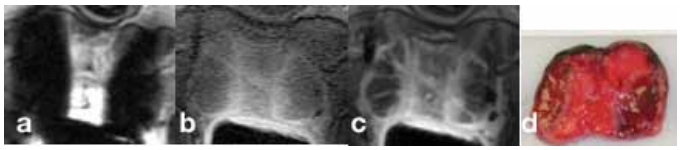

Figure 1.(a) FSE image at the height of freezing. Dynamic CE (b) and 3D SPGR (c) images demonstrate areas that do not enhance and the rim of hyperenhancement. (d) TTC image that suggests the hyperintense rim is within the pink-staining normal tissue region.

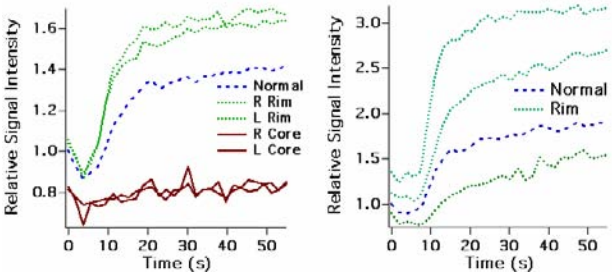

Figure 2. Enhancement curves from the experiment shown in Figure 1 (left) that demonstrate that this rim enhances more than the more normal tissue. A short time of hypointensity is also seen as the contrast agent moves through the tissue. Enhancement curves from 3 ROIs in the second experiment demonstrate variable timecourses (right).

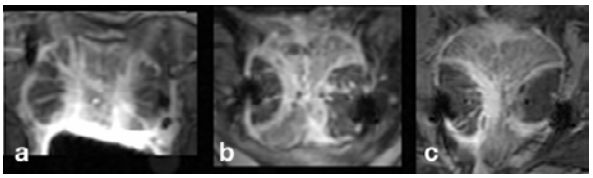

Figure 3. Hyperintense rim enhancement following cryoablation is variable in size between experiments and even within the same cryolesion.

Discussion

The results of this study suggest that the hyperintense rim seen on dynamic contrast enhanced MRI following prostate cryoablation may be within the normal staining pink area on TTC stained sections. Differences in the size and enhancement curves of the hyperenhancing rim may be due to differences in the underlying tissue structure, such as the presence of chronic prostatitis, interstitial fibrosis, and cystic hyperplasia that are scattered throughout the gland in the old dogs that were studied.

Acknowledgements

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References

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