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Renal Vein Thrombosis Alters Treatment Times and Temperatures in Renal Tumor Radiofrequency Ablation

S. Justin Lee, Julia K. Locklin, and Bradford J. Wood

Diagnostic Radiology Department, Clinical Center and Urologic Oncology Branch, National Cancer Institute, National Institutes of Health, Bethesda, Maryland

Editor:

Radiofrequency (RF) ablation of tumors is being utilized for therapy as well as palliation. When the target tumor is located in a heavily perfused organ such as the kidney, or near a large vessel, the heat sink phenomenon (or convective heat loss from blood flow) may require alteration in the treatment plan or algorithm to attain sufficient temperatures for complete ablation of tissue exposed to high blood flow. Conversely, the presence of portal vein thrombosis may make RF ablation of hepatic lesions subject to less heat loss (1). Methods of exploiting this phenomenon by altering blood flow to the liver or kidney via balloon occlusion or embolization have been described (2).

Renal tumors with renal vein thrombosis have less convective heat loss as a result of slow overall flow and absence of native renal vein flow. This may be analogous to liver RF ablation with hepatic vein or portal vein occlusion. We have previously reported RF ablation as a technique to palliate patients with transfusion-dependent, recalcitrant hematuria secondary to renal tumors (3). This approach was utilized in a 71 year old man with renal cell carcinoma metastatic to bone, liver and retroperitoneal lymph nodes who presented with repeated bouts of gross hematuria, requiring blood transfusion. CT scan revealed a 5 × 7 cm left renal mass with extension of the tumor into the renal pelvis and renal vein (Fig 1). For palliative intent to stop hematuria, RF ablation of the left kidney lesion was performed utilizing a 15cm Cool-tip single electrode with a 30 mm active tip (Valleylab, Boulder, CO). Seven cm diameter is larger than most renal RF ablation's performed at our institution, however complete ablation is not required to palliate for hematuria.

The kidney was ablated in four different medullar locations, without violation of the central renal pelvis. The time from onset of RFA to pulsing mode was 75 seconds. During treatment of three of the four sites, temperature at the electrode tip (during brief "spot checks" of temperature) reached 90C after less than 1 minute of treatment. These spot checks are usually obtained after an RF ablation is complete by turning off the chilled water pump and letting the temperature equilibrate. In this case, we Target temperature was reached markedly earlier than that expected for a lesion of this size and location, compared to hundreds (over 9 y) of historical renal tumor controls treated with the identical ablation system. The time to pulsing mode (or the time to logarithmic impedance rise) may correlate with local convective heat loss from large nearby vessels, although this is somewhat speculative and anecdotal. In this case, the time until pulsing mode started was 75 seconds after initiation of RF ablation. A retrospective analysis of 40 random recent renal tumor RF ablation's with identical Cool-Tip, 30mm tip, single electrode system showed a mean of 5 minutes 12 seconds and a median of 4 minutes 30 seconds (SD 2.7 min)

The early pulsing mode and high temperatures attained caused the operators to arrest RF ablation prior to the usual full 12 minutes of RF ablation, due to a desire to decrease the risk for collateral damage or complication such as fistula, infarct, urinoma, or bleeding, since the

electrode was located in the central parenchyma, where those risks may be higher than otherwise. Although attaining target tip temperature is not a recognized endpoint for the Cool-Tip device, the information may be of help in our experience. For example, the time that it takes to begin pulsing mode is the time that it takes the impedance to rapidly rise, and this interval seems to correlate with overall global perfusion mediated convective heat loss, although we have not analyzed our data nor reported this. When the electrode is residing close to a major vessel, the time to pulsing appears longer [again, this is anecdotal]. All patients in our institution are on IRB-approved protocols, however no IRB approval was specifically required for this procedure, as RF ablation for hematuria is standard of care therapy at our institution. The patient died of a drug overdose 7 weeks post-RFA, however was without hematuria from RF ablation until his death.

Renal cell carcinomas have a peculiar propensity to grow into the renal vein and inferior vena cava, and this may occur in up to 10% of cases (4). When RF ablation is being utilized to treat these lesions, the RF ablation algorithm may need to be adjusted accordingly, as absence of blood flow away from the kidney by the usual native routes results in reduced convective heat loss, and achievement of target temperatures at a markedly faster rate. This venous thrombosis effect may be difficult to predict, since variable degrees of collateral venous drainage may develop when venous obstruction occurs insidiously, and this may decrease the effect. Patients with renal vein thrombosis who undergo thermal ablation with RF ablation may require much less treatment times, current density, or energy deposition than patients with intact renal blood flow. Advance knowledge of this effect may help better plan for more effective RF ablation, and may justify consideration of more generous inclusion criteria for tumor size, although this is speculative.

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Figure 1.
Left renal mass invading renal pelvis with renal vein thrombus (arrow).