

Case Series: Minimally Invasive 3 Tesla Interventional MRI

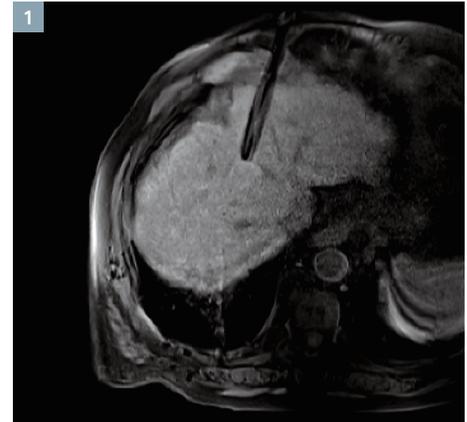
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Case 1

76-year-old man with cirrhosis was discovered to have a 2.5 cm lesion in segment 4/8 of the liver suspicious for a hepatocellular carcinoma (HCC). This was visualized on a 1.5 Tesla MRI study only with the use of i.v. contrast. It was not seen by ultrasound or CT scan. Hence, MRI-guided biopsy was performed in 3 Tesla MRI (MAGNETOM Verio, Siemens Healthcare, Erlangen, Germany).

Using spine coil elements and body matrix coil, the lesion is seen as a T1 hyperintense mass (Fig. 1). This was used to guide 22 gauge MRI-compatible needles into the mass and Fine-needle aspiration (FNA) biopsy was performed under local anesthesia and i.v. procedural sedation. The patient tolerated the procedure well without complications and the pathology proved the lesion to be an HCC.



1 MRI guided liver biopsy.
Intraprocedural axial T1-weighted SPGR (VIBE) shows liver lesion and biopsy needle*.

Case 2

65-year-old woman with history of breast cancer and a newly discovered 1.3 cm left kidney upper pole lesion suspicious for tumor. To differentiate between metastasis versus a renal origin tumor, percutaneous biopsy was indicated. However, this small renal mass was embedded in the renal parenchyma and very difficult to see with other imaging modalities except for MRI where it was well visualized even without the use of i.v. contrast material. 3T MRI (MAGNETOM Verio, Siemens Healthcare, Erlangen, Germany) with spine coil elements and body matrix coil was used for imaging.

Axial T2w TSE respiratory triggered sequence (BLADE) provided excellent visualization of the small lesion and needle location (18 gauge MRI-compatible) with minimal artifact (Fig. 2). The procedure was performed under local anesthesia and i.v. procedural sedation. The patient tolerated the procedure well without complications. Pathology showed mucinous tubular and spindle cell carcinoma, a low grade primary cancer of the kidney.



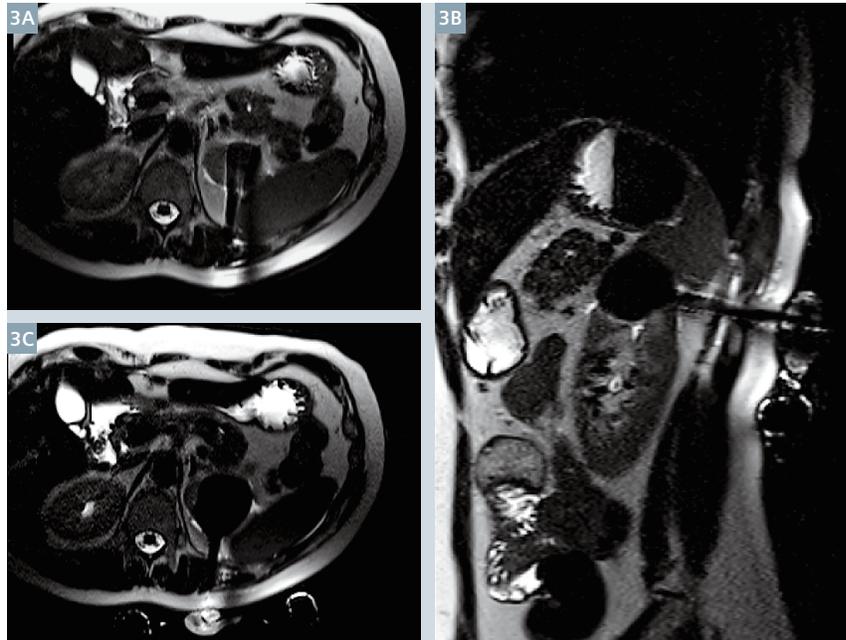
2 MRI guided kidney biopsy.
Intraprocedural axial T2w respiratory triggered TSE (BLADE) shows the 18 gauge biopsy needle in the small renal mass.

*Metal: The MRI restrictions (if any) of the metal implant must be considered prior to patient undergoing MRI exam. MR imaging of patients with metallic implants brings specific risks. However, certain implants are approved by the governing regulatory bodies to be MR conditionally safe. For such implants, the previously mentioned warning may not be applicable. Please contact the implant manufacturer for the specific conditional information. The conditions for MR safety are the responsibility of the implant manufacturer, not of Siemens.

Case 3

57-year-old woman with a 2 cm left kidney upper pole biopsy proven renal cell carcinoma. Its small size and intraparenchymal location in the upper pole renders it challenging for partial nephrectomy. Since it is well seen on MRI, cryoablation using MRI guidance was preferred as a minimally-invasive nephron-sparing treatment option. 3T MRI (MAGNETOM Verio, Siemens Healthcare, Erlangen, Germany) with spine coil elements and an 11 cm loop coil was used for imaging.

Axial and sagittal HASTE sequence was used to place three 17 gauge MRI-compatible cryoablation probes (Galil Medical, Plymouth, PA USA) and to monitor the ablation (Fig. 3). This helped cover the tumor completely while preventing injury to adjacent pancreas and adrenal gland. The procedure was performed in the prone position under general anesthesia without complications.



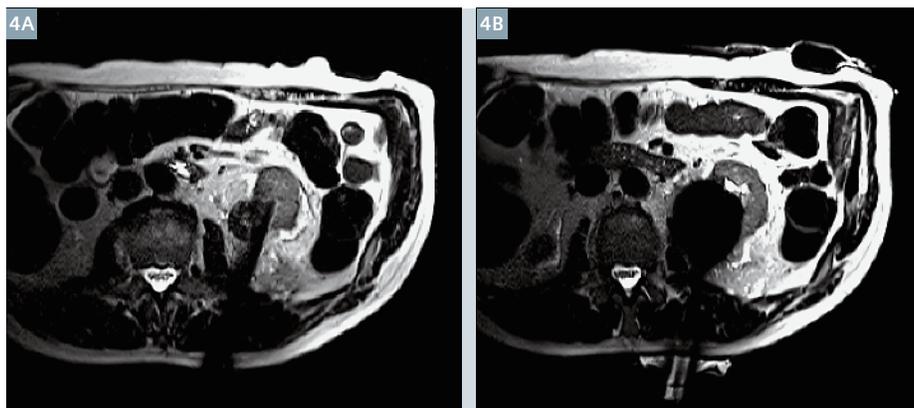
3 Cryoablation of native renal mass. (3A) Intraprocedural axial T2w HASTE shows two of the probes in the renal tumor. (3B) Sagittal T2w HASTE obtained 10 min into the 2nd freezing cycle shows the iceball close to adjacent pancreas but without overlap. (3C) Axial T2w HASTE obtained at the end of the 2nd 15 min freezing cycle shows that the iceball has eclipsed the tumor and is close to the adjacent adrenal gland but without overlap.

Case 4

68-year-old man with a 2.9 cm left lower pole biopsy proven renal cell carcinoma, discovered during hematuria workup. Due to comorbid coronary artery disease, patient was referred for minimally invasive, nephron sparing image-guided cryoablation. MRI guidance was preferred due to tumor proximity to ureter to minimize risk

of injury. 3T MRI (MAGNETOM Verio, Siemens Healthcare, Erlangen, Germany) with spine coil elements and body matrix coil was used for imaging. Axial T2W HASTE sequence was used to place three 17 gauge MRI-compatible cryoablation probes (Galil Medical, Plymouth, PA USA) and to monitor the ablation (Fig. 4).

This ensured covering the tumor completely while preventing injury to adjacent ureter. The procedure was performed in the prone position under local anesthesia and i.v. procedural sedation. The patient tolerated the procedure well without complications.



4 Cryoablation of native renal mass. (4A) Intraprocedural axial T2w HASTE shows first of the three probes being placed in the renal tumor. (4B) Intraprocedural axial T2w HASTE obtained at the end of the 2nd 15 min freezing cycle shows that the iceball has eclipsed the tumor without overlapping adjacent proximal ureter.



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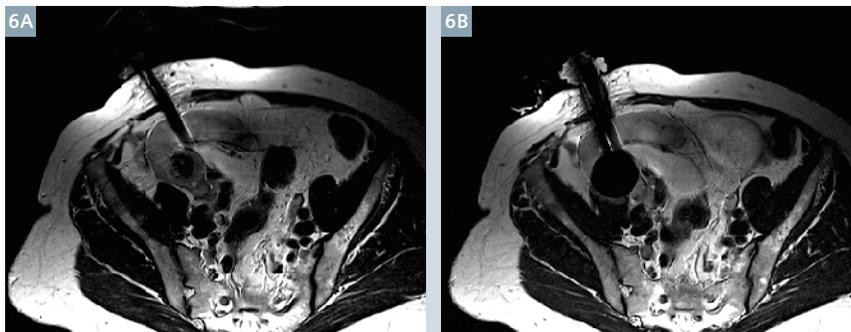
Cryoablation of native renal mass. (5A) Intraprocedural axial T2w HASTE shows first of the three probes being placed in the renal tumor. (5B) Intraprocedural axial T2w respiratory triggered TSE (BLADE) obtained at the end of the 2nd 15 min freezing cycle shows that the iceball has eclipsed the tumor without overlapping adjacent colonic wall.

Case 5

68-year-old man with 2.4 cm left lower pole renal cell carcinoma. Due to history of lung cancer, cutaneous T-cell lymphoma and chronic lymphocytic leukemia, he was referred for percutaneous cryoablation as a minimally invasive, nephron sparing treatment option.

3T MRI (MAGNETOM Verio, Siemens Healthcare, Erlangen, Germany) with spine coil elements and body matrix coil was used for imaging. Axial T2w HASTE sequence was used to place three 17 gauge MRI-compatible cryoablation probes (Galil Medical, Plymouth, PA USA) (Fig. 5A). Then, for more detailed monitoring of the ablation, we utilized an axial T2w

respiratory triggered TSE (BLADE) sequence (Fig. 5B). This ensured covering the tumor completely while preventing injury to adjacent colon. The procedure was performed in the prone position under local anesthesia and i.v. procedural sedation. The patient tolerated the procedure well without complications.



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Cryoablation of renal transplant mass. (6A) Intraprocedural axial T2w TSE shows first of the three probes being placed in the renal tumor. (6B) Intraprocedural axial T2w TSE obtained at the end of the 2nd 15 min freezing cycle shows that the iceball has eclipsed the tumor without overlapping adjacent renal pelvis.

Case 6

66-year-old woman with a 2.1 cm biopsy proven renal cell carcinoma inside of a renal transplant located in her right lower abdomen. She was referred for percutaneous cryoablation as a minimally-invasive nephron-sparing treatment option. The tumor margins were not well seen on ultrasound or CT scan due to its small size and intraparenchymal location.

However, MRI showed the tumor very well. 3T MRI (MAGNETOM Verio, Siemens Healthcare, Erlangen, Germany) with spine coil elements and an 11 cm loop coil was used for imaging.

Axial T2w TSE sequence was used to place three 17 gauge MRI-compatible cryoablation probes (Galil Medical,

Plymouth, PA USA) and to monitor the ablation (Fig. 6). This ensured covering the tumor completely while preventing injury to adjacent renal pelvis and ureter. The procedure was performed in the supine position under local anesthesia and i.v. procedural sedation. The patient tolerated the procedure well without complications.



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