Cryoablation of renal tumors

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Disclosure

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I have the following potential conflicts of interest to report:

☐ Consulting
☐ Employment in industry
☐ Stockholder of a healthcare company
☐ Owner of a healthcare company
☐ Other(s)

☒ I do not have any potential conflict of interest
General Guidelines for cryoablation 1,2

- **Indications**
  - T1a (< 4 cm) renal mass in patients who:
    - comorbidities preclude surgery/general anesthesia
    - prefer minimally invasive techniques over open or laparoscopic surgery
    - require conservation of renal parenchyma (solitary kidney, renal insufficiency)
    - multiple renal tumors (make renal function difficult) or complex renal tumors (need extended ischemic time)

- **Contraindications**:
  - absolute: uncorrectable coagulopathy (INR > 1.5, Plt < 50,000/µL)
  - relative:
    - anatomical considerations with unsafe access (anteromedial masses)
    - high risk of incomplete ablation (large lesion, T1b)

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Percutaneous Cryoablation for Stage 1 Renal Cell Carcinoma: Outcomes from a 10-year Prospective Study and Comparison with Matched Cohorts from the National Cancer Database

- For stage I renal cell carcinoma, 10-year overall survival was longer after percutaneous cryoablation compared with both partial and radical nephrectomy (72% vs 49% and 43%; P < .001). This benefit was noted across all ages and all comorbidity levels.

- The 10-year disease-specific survival was 94% and was comparable to that reported for surgical interventions.

- Percutaneous cryoablation was associated with a low rate of complications (8%), as well as a low 10-year risk of hemodialysis (2%).

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Survival curves for 134 patients showed disease-specific survival was 94% ± 2.1 at both 5 years and 10 years after diagnosis. Recurrence-free survival was calculated at 85.9% ± 2.9 and 69.1% ± 5.1 at 5 years and 10 years, respectively.

Morkos J et al. Published Online: June 9, 2020
https://doi.org/10.1148/radiol.2020192325
Before you decide, just look to...

- Patient specific factors (Age and co-morbidities, baseline renal function)
- Lesion specific factors (Size, Location and perinephric fat)
- Biopsy and RCRY vs Biopsy then RCRY

✓ Small renal mass: sensitivity 80-92%, specificity 80-100%
✓ it could be considered if you have:
- Extrarenal malignancy,
- suspected lymphoma
- Renal mass associated with urinary tract infection

- Available of experience and Arrangement with anesthesia

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1 Renal cryoablation – a practical guide for interventional radiologists, Br J Radiol. 2021 Feb 1; 94(1118): 20200854
2 CIRSE Guidelines on Percutaneous Ablation of Small Renal Cell Carcinoma, CVIR volume 40, pages 177–191 2017
Patient Position and Best procedure Approach 1,2,3

Most comfortable position that facilitates procedural access and decrease rate of complications

- Ipsilateral side down
  - optimal for upper pole renal masses
  - Lung displaced, reducing risk of pneumothorax
  - decrease movement of ipsilateral kidney

- Prone
  - suitable for lower pole renal masses
  - subcostal approach; angle gantry if necessary
Most comfortable position that facilitates procedural access

- **30° oblique (ipsilateral side up)**
  - Suitable for anterior masses
  - Allows movement of bowel from ablation zone

- **Oblique supine**
  - Suitable for anterior/lateral masses
  - Liver, spleen, and colon should not be in trajectory

Fig. 1. 70 year-old obese female with multiple medical and surgical comorbidities and an incidentally diagnosed endophytic left renal mass. CT image demonstrates that after placement of trocar for hydrodissection and administration of 300 mL sterile normal saline, there is no displacement of bowel (A). A guidewire was then placed via the trocar to prepare for angioplasty balloon interposition. After inflation of the 10 mm diameter balloon, there is now displacement of bowel 20 mm away from the lesion, allowing for adequate ablation (B). CT image 48 months after the procedure demonstrates no bowel abnormality and no evidence of viable tumor (C).
Protecting important structures?

Table 1. Anatomical structures to consider based on lesion location

<table>
<thead>
<tr>
<th>Structures requiring protection</th>
<th>Anatomical structures at</th>
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Table 2. A summary of thermal sensitive structures and means of protection during renal tumour cryotherapy

<table>
<thead>
<tr>
<th>Structures requiring protection</th>
<th>Patient positioning</th>
<th>Primary protective methods</th>
<th>Secondary protective methods</th>
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<tbody>
<tr>
<td>Lung</td>
<td>Ipsilateral side-down</td>
<td>Artificial pneumothorax</td>
<td>Angle gantry/transhepatic treatment</td>
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<td>Pleura</td>
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<td></td>
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<tr>
<td>Bowel</td>
<td>Ipsilateral side-up</td>
<td>Hydrodissection</td>
<td>Balloon interposition/probe torque</td>
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<td>Pancreatic tail</td>
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<tr>
<td>Rib neurovascular bundle,</td>
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<tr>
<td>abdominal wall, genitofemoral</td>
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<td>nerve</td>
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<tr>
<td>Ureter</td>
<td></td>
<td>Stent</td>
<td>Pneumodissection/probe torque</td>
</tr>
<tr>
<td>Collecting system</td>
<td></td>
<td>Renal sinus pneumodissection</td>
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</tbody>
</table>

1 Renal cryoablation – a practical guide for interventional radiologists, Br J Radiol. 2021 Feb 1; 94(1118): 20200854
Figure 9. CT images in a 69-year-old woman with biopsy-proven RCC. (a, b) Axial CT images obtained with the patient in the supine (a) and decubitus (b) positions show a 4.0 x 3.5-cm RCC in the left anterior kidney (arrows). The pancreas (arrowhead) is closely adjacent to the RCC in a, which increases the risk associated with heat-based ablation, and the relationship does not change in b with the patient in the decubitus position. The RCC was targeted for cryoablation with US guidance. (c) Axial contrast-enhanced CT image shows that hydrodissection (high-attenuation fluid) was used to displace the pancreas (arrowhead), and the RCC was ablated successfully with three 15-gauge cryoprobes and a 10-, 5-, 10-minute freeze-thaw-freeze protocol. Note that the visibility of the ice ball (arrows) makes the ablation precise. (d) On an axial 6-month follow-up CT image, the RCC (arrows) shows no substantial enhancement and has decreased in size, as expected. The patient had no evidence of pancreatitis or other complications.
Figure 7. (A) Despite an ipsilateral side-down prone position the right posterior chromophobe renal cell carcinoma (arrow) in this 64-year-old female cannot be accessed without traversing the lung. (B) A 22G needle was passed into the pleural space under CT guidance and carbon dioxide injected to create a pneumothorax. A chest drain was inserted and clamped (not shown). (C) Cryo-ablation treatment probes were passed through the pneumothorax without traversing the lung. The pneumothorax was aspirated at the end of the procedure.
Pneumo- und Hydrodissection with Double J Catheter

1 Renal cryoablation – a practical guide for interventional radiologists, Br J Radiol. 2021 Feb 1; 94(1118): 20200854
How to do it?

- Vital signs Monitoring and put the patient in comfortable position
- Sedation/Anesthesia
- Insert cryoprobe and confirm needle placement under CT guidance

- Ablation with 2 freeze-thaw-cycles
  - Duration: 10 minutes, 8 minutes thaw, 10 minutes freeze
  - Scan every 2-5 minutes: Assess ice ball size
  - Ice ball formation is hypodense on CT, hypointense on MR, and shadowing on US

- Goal is ice ball margin at least 5 mm past desired ablation margin
  - Ice ball margin represents 0°C isotherm (insufficient for cell death)
  - Cytotoxic ice formation in renal cells occurs below -20°C temperature, but it has been suggested that renal tumors require an even lower temperature, a finding mirrored in other malignancies, where a goal of -40°C is suggested.

1 Renal cryoablation – a practical guide for interventional radiologists, Br J Radiol. 2021 Feb 1; 94(1118): 20200854.
3 Percutaneous renal Ablation STAT-Dx
Percutaneous Tumor Ablation Tools: Microwave, Radiofrequency, or Cryoablation—What Should You Use and Why?

J. Louis Hinchliffe, MD • Meghan G. Lubner, Jeph L. Bruce, PhD

RadioGraphics 2014; 35:1344–1362 • Publish

System performance can vary widely, so it is important to understand the shapes and sizes created by different times and techniques.

**Figure 11.** Flowchart shows the recommended modality choices for kidney ablation. *AML* = angiomyolipoma, *Cryo* = cryoablation, *MW* = microwave.
Conclusions

- RCRY is widely accepted, safe and efficacious treatment.
- Pre-procedural MDT discussion is important in order to ensure appropriate patients are selected.
- Probe selection and configuration should be based on manufacturer-specific guidance, lesion size and other anatomical factors.
- Achieving adequate margins and safe the adjacent structures.