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Silvia M. Mendoza
Misericordia University

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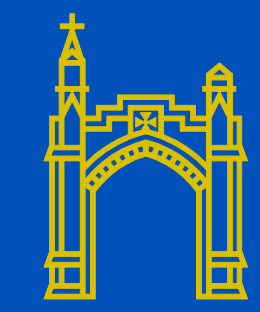
Mendoza, Silvia M., "Treatment of Clear Cell Renal Cell Carcinoma (ccRCC) in Interventional Radiology" (2026). *Student Research Poster Presentations 2026*. 1.
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Treatment of Clear Cell Renal Cell Carcinoma (ccRCC) in Interventional Radiology

Student Researcher: Silvia M. Mendoza

Faculty Advisor: Dr. Elaine Halsey, Ed.D., R.T. (R)(QM)(ARRT)



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What is Clear Cell Renal Cell Carcinoma (ccRCC)?

Cleveland Clinic (2024) explains that:

- Clear cell renal cell carcinoma is the most common type of kidney cancer and develops in the small tubes of the kidney that filter blood.
- The name “clear cell” comes from the appearance of the cancer cells under a microscope.
- ccRCC is different from other kidney cancers because of its specific genetic changes and tumor characteristics, influencing how the tumor grows and how doctors approach treatment (Lopez & Manini, 2024).
- Biopsy procedures performed with imaging guidance can help confirm a diagnosis of kidney cancer (Cleveland Clinic, 2024).



Radiofrequency Ablation (Beheshtian, 2024, “Risks and Complications” section). Procedure shows where the probes are inserted through the skin. Probes deliver heat energy directly to the tumor.

What is Interventional Radiology?

As described by Abdelsalam et al. (2025),

- Interventional radiology is a medical specialty that uses imaging equipment such as CT scans, MRI, and ultrasound to guide minimally invasive procedures.
- Instead of large surgical incisions, interventional radiology procedures typically use small probes or needles inserted through the skin to reach the tumor.
- These procedures use imaging guidance to directly target tumors while preserving surrounding healthy tissue.
- These minimally invasive treatments are becoming more common because they often have shorter recovery times and fewer complications than traditional surgery.
- Techniques used in interventional oncology include tumor ablation and embolization.

Symptoms

According to the Cleveland Clinic (2024):

- ccRCC is typically asymptomatic in its early stages
- Blood found in the urine (hematuria)
- Feeling tired (fatigue)
- Fever
- Flank pain on the affected side
- Unexplained weight

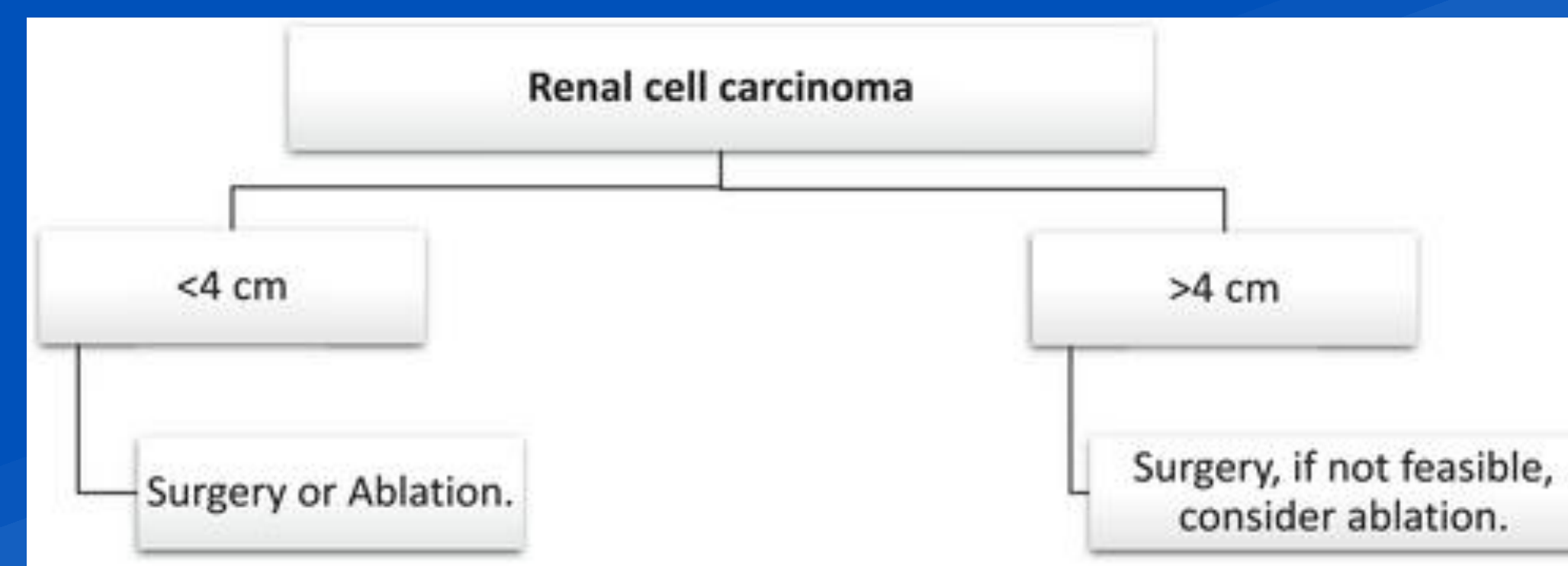


Figure 2 (Abdelsalam et al., 2025, p. 5). This diagram demonstrates how tumor size can influence treatment decisions for renal cell carcinoma.

Prognosis

Rathmell et al. (2022) state:

- Prognosis for patients with ccRCC depends on factors such as tumor size, stage of the cancer, and the patient’s overall health.
- When the cancer has metastasized, treatment decisions are often based on risk categories to help determine the most appropriate form of treatment.
- Risk classification systems, such as the International Metastatic RCC Database Consortium (IMDC), are used to help make treatment decisions.
- The overall five-year survival rate for people diagnosed with ccRCC is estimated to be 50–69% (Cleveland Clinic, 2024).
- Renal cell carcinoma typically occurs in 12 out of 100,000 individuals in North America, peaking at the range of 60-70 years (Lopez & Manini, 2024).
- Kidney cancer occurs more in men, and ranks as the sixth most common cancer, while in women it is ranked ninth (Yang et al., 2023).
- Image-guided biopsies may be used to confirm the diagnosis of ccRCC (Cleveland Clinic, 2024).

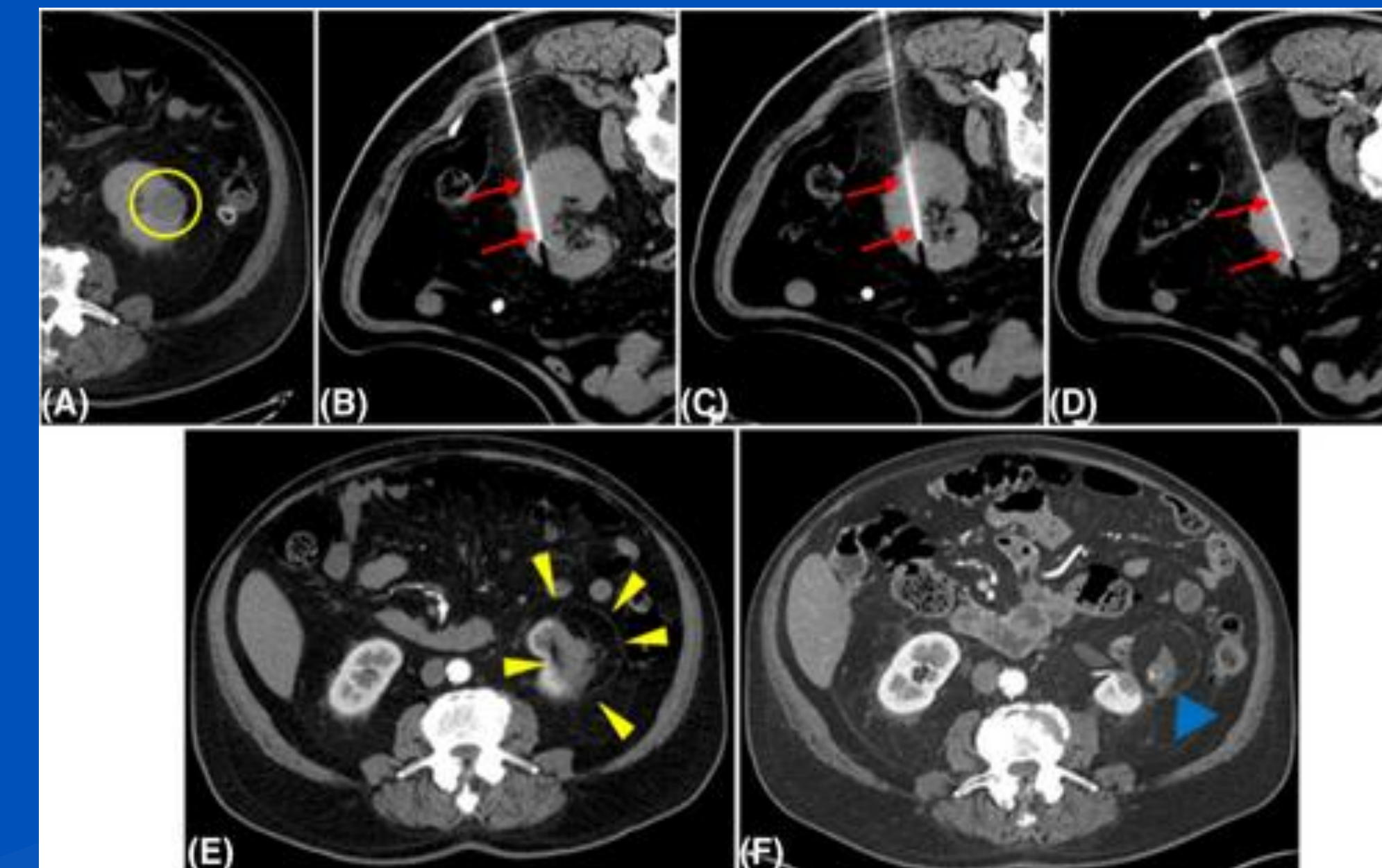


Figure 1 (Abdelsalam et al., 2025, p. 4). (A) CT scan identifying the renal tumor (B) Placement of the ablation probe into the tumor (C) Adjustment and positioning of the probe (D) Delivery of thermal energy through the probe (E) CT image showing the treated region (F) Follow up image demonstrating the treated area

Ablation Treatment

- Ablations are a minimally invasive procedure used to destroy kidney tumors (Khan et al., 2025).
- These procedures are a good alternative option for patients who are not good candidates for traditional surgery (Abdelsalam et al., 2025).
- During the procedure, a probe is inserted into the tumor using imaging guidance to precisely target the cancer (Khan et al., 2025).
- Types of ablation include radiofrequency ablation, microwave ablation, and cryoablation (Abdelsalam et al., 2025).
- The goal is to destroy cancer cells while limiting damage to nearby healthy kidney tissue (Khan et al., 2025).
- Thermal ablation is especially effective for small renal tumors about 4 cm or smaller (Khan et al., 2025).
- Radiofrequency ablation uses electrical energy to generate heat to destroy tumors (Abdelsalam et al., 2025).
- Microwave ablation uses electromagnetic energy to generate high temperatures to destroy tumors (Abdelsalam et al., 2025).
- Cryoablation works by using extremely cold temperatures to freeze and destroy tumors (Abdelsalam et al., 2025).

Other Treatments

As described by Yang et al. (2025):

- Traditional treatment for kidney cancer often includes surgery to remove part or all of the kidney, known as a nephron-sparing surgery or nephrectomy.
- Other treatment options include targeted therapy and immunotherapy.
- Targeted therapies are designed to block pathways that allow cancer cells to grow and spread.
- Immunotherapy is the use of the body’s immune system to identify and attack cancer cells.
- Cytokine therapy has also been used as a treatment option for some patients, which involves the use of soluble proteins to assist the body in fighting cancer.
- Researchers are also studying combinations of treatments to improve patient outcomes.

Conclusion

- Immune checkpoint inhibitor therapy (ICI) is another option that has revolutionized treatment and improved outcomes compared to targeted molecular therapies (Lopez & Manini, 2024).
- Ongoing research is also exploring new technologies including artificial intelligence models that may help predict cancer recurrence and improve treatment planning (Maqsood & Khan, 2025).
- New research has developed computer-based prediction models for ccRCC recurrence which have shown prediction accuracy as high as 98.3% F1 score (Maqsood & Khan, 2025).



Microwave ablation under CT guidance (Haslam, 2021, “The needle is repositioned” section). This image shows a patient positioned inside a CT machine during a microwave ablation procedure.