

# Canadian Urological Association guideline for followup of patients after treatment of non-metastatic renal cell carcinoma

Wassim Kassouf, MD<sup>1</sup>; Leonardo L. Monteiro, MD<sup>1</sup>; Darrel E. Drachenberg, MD<sup>2</sup>; Adrian S. Fairey, MD<sup>3</sup>; Antonio Finelli, MD<sup>4</sup>; Anil Kapoor, MD<sup>5</sup>; Jean-Baptiste Lattouf, MD<sup>6</sup>; Michael J. Leveridge, MD<sup>7</sup>; Nicholas E. Power, MD<sup>8</sup>; Frederic Pouliot, MD<sup>9</sup>; Ricardo A. Rendon, MD<sup>10</sup>; Robert Sabbagh, MD<sup>11</sup>; Alan I. So, MD<sup>12</sup>; Simon Tanguay, MD<sup>1</sup>; Rodney H. Breau, MD<sup>13</sup>

<sup>1</sup>Division of Urology, McGill University Health Centre, Montreal, QC; <sup>2</sup>Section of Urology, University of Manitoba, Winnipeg, MB; <sup>3</sup>Division of Urology, University of Alberta, Edmonton, AB; <sup>4</sup>Division of Urology, University of Toronto, Toronto, ON; <sup>5</sup>Division of Urology, McMaster University, Hamilton, ON; <sup>6</sup>Division of Urology, University of Montreal, Montreal, QC; <sup>7</sup>Department of Urology, Queen's University, Kingston, ON; <sup>8</sup>Division of Urology, Western University, London, ON; <sup>9</sup>Division of Urology, Laval University, Quebec City, QC; <sup>10</sup>Department of Urology, Dalhousie University, Halifax, NS; <sup>11</sup>Division of Urology, University of Sherbrooke, Sherbrooke, QC; <sup>12</sup>Department of Urologic Sciences, University of British Columbia, Vancouver, BC; <sup>13</sup>Division of Urology, University of Ottawa, Ottawa, ON; Canada

Cite as: *Can Urol Assoc J* 2018;12(8):231-8. <http://dx.doi.org/10.5489/cuaj.5462>

Published online May 31, 2018

## Introduction and objectives

Renal cell carcinoma (RCC) accounts for approximately 3% of all malignancies. RCC is about twice as common in males. It is the seventh most common cancer and 11th most common cause of cancer-related deaths among men.<sup>1,2</sup> Cigarette smoking, obesity, and hypertension are the most well-established risk factors for sporadic RCC.<sup>3-6</sup> Acquired cystic kidney disease (ACKD) is also a significant risk factor.<sup>7</sup> Other studies have linked occupational exposure to RCC.<sup>8-9</sup> As many as 5% of patients with RCCs are associated with germline mutations. There are a number of different hereditary diseases that are associated with RCC, including von Hippel-Lindau (VHL), hereditary papillary renal carcinoma (HPRC), Birt-Hogg-Dubé (BHD), hereditary leiomyomatosis renal cell carcinoma (HLRCC), succinate dehydrogenase kidney cancer (SDH-RCC), tuberous sclerosis complex (TSC), and Cowden's disease.<sup>10-14</sup> There are different options for management of patients with clinically localized renal masses suspicious for RCC, including active surveillance, ablation, and surgery. Comparing the non-surgical with the surgical approach (partial [PN] or radical nephrectomy [RN]) for small renal masses, the surgical approach may be associated with better oncological outcomes based on large observational studies;<sup>15-18</sup> however, no prospective randomized studies have been completed.

Patients with newly diagnosed RCC are living longer after diagnosis, largely due to incidental diagnoses and subsequent migration to earlier stages of disease.<sup>4</sup> Surveillance

after treatment is important since some patients are at high risk of asymptomatic cancer recurrence and these recurrences may respond better to treatment if detected early.

Observation remains the standard of care after nephrectomy. Surveillance protocols after treatment of the primary RCC tumour focus on oncological control, functional preservation, and survivorship. Publications that address surveillance after surgical extirpation are based on retrospective analysis, including some larger multicentre studies and well-designed controlled studies.<sup>19</sup> There are no randomized trials of surveillance strategies, but an evidence-based approach to followup can be achieved by assessing the timing and location of RCC recurrence in a risk-stratified manner. This updated guideline attempts to provide some clarity and guidance for the practicing urologist based on the current literature.

## Methods

A systematic search of the PubMed and MEDLINE databases was conducted. The searches were limited to English-language publication. The main search terms used to identify eligible studies from the databases combined patient terms (renal or kidney carcinoma/tumour/neoplasm/cancer), intervention terms (RN, PN, nephron-sparing surgery, ablation), and followup. Where possible, levels of evidence (LE) and grades of recommendations (GR) are provided employing the International Consultation on Urologic Disease (ICUD)/World Health Organization (WHO) modified Oxford Centre for Evidence-based Medicine grading system.<sup>20</sup> The level of evidence was summarized according to the following: Level 1: systematic review of randomized controlled trials (RCT); Level 2: individual RCT, including low-quality RCT; Level 3: controlled cohort; Level 4: case-control studies or case series; Level 5: expert opinion, mechanism-based reasoning. Based on these levels of evidence, we have graded recom-

recommendations as follows: Grade A: usually consistent with Level 1 studies; Grade B: consistent with Level 2 or 3 studies or extrapolations from Level 1 studies; Grade C: Level 4 studies or extrapolations from Level 2 or 3 studies; Grade D: Level 5 evidence or inconsistent/inconclusive studies of any level.

The present guideline was organized into three major topics:

1. Rationale for surveillance
2. Prognostic variables
3. Stage-stratified surveillance recommendations

The main objective is to present the rationale and guide the post-treatment followup in patients with localized and locally advanced RCC.

## 1. Rationale for surveillance

Surveillance after treatment allows the urologist to monitor for postoperative complications, renal function, local recurrence, recurrence in the contralateral kidney, and development of metastases. Surveillance is usually accomplished with physical examination, radiological imaging, and serum biochemistry testing.

Chronic kidney disease (CKD) is recognized as a public health problem worldwide, with prevalence from 8–16%, and potentially associated with progression to end-stage renal disease (ESRD), cardiovascular disease, and increased mortality rates.<sup>21,22</sup> Decreased kidney function refers to a decreased glomerular filtration rate (GFR <60ml/min/1.73m<sup>2</sup>), which is usually estimated (eGFR) using serum creatinine and one of several available equations.<sup>23</sup> Huang et al showed, in a retrospective study, that 26% of patients with solitary small renal mass (≤4 cm) surgically managed had CKD on the basis of Modification of Diet in Renal Disease equation.<sup>24</sup> Several retrospective studies have demonstrated impairment of renal function after treatment for RCC; RN is a significant risk factor for the development of CKD.<sup>25-27</sup> Renal function decreases postoperatively and usually improves over time until a new baseline is achieved in approximately 3–6 months.<sup>28</sup> The aim of renal function surveillance is to prevent or delay CKD and avoid dialysis. Renal function and postoperative complications are commonly assessed by history, physical examination, and measurement of serum creatinine and hemoglobin at 4–6 weeks post-surgery. Long-term monitoring of serum creatinine, eGFR, and proteinuria is recommended, particularly in patients with compromised renal function prior to surgery or significant decrease in eGFR after surgery. **Consideration for referral to a nephrologist if eGFR <45 ml/min/1.73m<sup>2</sup> or progressive CKD develops after surgery, especially if associated with proteinuria (Level 2 evidence, Grade B recommendation).**<sup>29-31</sup>

Radiological imaging plays an important role at diagnosis for renal mass, as well as followup after treatment for RCC. Surveillance in patients after treatment of RCC should be

adapted and based on known independent predictors of postoperative recurrence to optimize the use of radiological imaging. This understanding would avoid over-surveillance of patients at low risk for relapse and under-surveillance for those at high risk. It would also avoid unnecessary radiation exposure from radiological imaging, such as computed tomography (CT), since theoretically it can be associated with an increased risk of secondary malignancies.<sup>32,33</sup> Furthermore, a risk-adapted approach may also decrease the cost of surveillance on the healthcare system.<sup>34-36</sup> **Early diagnosis of local and contralateral kidney recurrence (incidence <2%) is useful, since the majority of these patients can be cured with treatment (Level 4 evidence, Grade C recommendation).**<sup>37-39</sup> Risk factors for ipsilateral renal recurrence are positive surgical margins, tumour multifocality, higher tumour stage, and higher tumour grade.<sup>40</sup> Tumours that develop in the contralateral kidney are more likely amendable to nephron-sparing treatments when detected earlier. Patients undergoing surgery for symptomatic recurrences have a higher rate of incomplete resection of recurrence, positive surgical margins, and worse survival compared to surgery without symptoms.<sup>41-43</sup> Extensive tumour recurrence reduces the possibility of complete surgical resection, which is standard therapy for patients with local recurrence or resectable solitary metastasis. Furthermore, an early diagnosis of metastatic disease relapse may enhance efficacy of systemic therapy or allow for metastasectomy if the tumour burden is low. **Therefore, this supports the rationale for surveillance of patients to detect recurrences and metastases early when they are more likely to be successfully treated (Level 4 evidence, Grade C recommendation).**

## 2. Prognostic variables

Predictors of disease relapse after surgical extirpation can be classified into anatomical (TNM classification system), histological, clinical, and molecular.<sup>44,45</sup> **Tumour grade, local extent of the primary tumour, presence of nodal metastasis, and histological subtype are predictors of the disease relapse (Level 3 evidence).**<sup>41,46-48</sup> As such, these variables should be noted because they contribute to important prognostic information.

Histological subtype is a significant predictor of survival and recurrence, regardless of type of surgical resection or tumour stage. RCC with collecting duct carcinoma, medullary carcinoma, and tumour with elements of sarcomatoid and rhabdoid dedifferentiation exhibit higher metastatic potential. Localized chromophobe and papillary RCC type 1 portend a better prognosis.<sup>49,50</sup> **Fuhrman nuclear grade is another important histological prognostic value, where higher grade is associated with worse prognosis in clear-cell RCC (Level 4 evidence).**<sup>51-53</sup>

**Clinical factors associated with prognosis include performance status (Eastern Cooperative Oncology Group**

[ECOG]), the presence of symptoms (localized or systemic), cachexia, anemia, platelet count, elevated erythrocyte sedimentation rate, and primary tumour characteristics (tumour size, histological coagulative necrosis, DNA ploidy) have also been shown to be associated with outcome (Level 4 evidence).<sup>41, 54-57</sup>

Molecular markers, including carbonic anhydrase IX, hypoxia-inducible factor, Ki67, p53, phosphatase, and tensin homolog (PTEN), regulator of apoptosis Bcl-2, E-cadherins, C-reactive protein (CRP), microRNAs (miR-21 and miR-126), and others, have demonstrated potential utility as prognostic markers, and vascular endothelial growth factor (VEGF) as predictive biomarker.<sup>58</sup> Higher level of PD-L1 expression has been linked with a negative prognostic factor in RCC. The role of molecular markers in RCC is expansive and can range from aiding pathological diagnosis, understanding the histogenesis of renal tumour, classifying new entities, and choosing appropriate therapy in patients who present with advanced disease, to the more investigative arena of elucidating predictive and prognostic behaviour of renal neoplasm. **However, use of molecular markers is not recommended in the routine clinical setting (Grade C recommendation).**<sup>59-65</sup>

### 3. Surveillance

Intensity and type of surveillance should vary depending on the risk of developing recurrence or metastases. The Canadian guidelines for surveillance after nephrectomy for non-metastatic RCC is risk-stratified based on pathological stage, but some patients may benefit from more or less intensive surveillance based on other risk factors presented above. There are several nomograms and scoring systems that combine different prognostic factors.<sup>66-69</sup> They classify patients into risk of relapse, progression, and survival. Although some of these nomograms have already been validated, they have not been widely used in routine clinical practice. Most of them are used to enrol patients in clinical trials. In the absence of randomized studies, surveillance recommendations are based on large, non-randomized cohorts with long-term followup. **To evaluate recurrence in the lung, routine chest x-ray (CXR) is recommended. In higher-risk patients, CT of the chest may be performed due to the higher sensitivity of this test compared to CXR (Level 5 evidence, Grade D recommendation). To evaluate abdominal recurrences, CT of the abdomen and pelvis is recommended, particularly in cases of tumour-associated symptoms; an abdominal ultrasound may be performed for lower-risk patients (pT1 and pT2) (Level 4 evidence, Grade C recommendation). CT head or bone scan is not routinely recommended unless clinically indicated (Level 4 evidence, Grade C recommendation).** Magnetic resonance imaging (MRI) has presented acceptable accuracy to detect musculoskeletal and lymph node metastases, but lower sensitivity to

detect pulmonary metastases when compared to CT.<sup>70</sup> MRI can be used to reduce radiation exposure from x-ray and CT during followup after treatment for renal cancer, since MRI does not involve the use of ionizing radiation. The use of gadolinium-based contrast agent in the MRI should be handled with caution because there is a slight chance of developing nephrogenic systemic fibrosis, mainly in patients with severe renal failure. Positron emission tomography (PET)-CT is a nuclear imaging modality with the ability to characterize molecular processes non-invasively during a fast whole-body scan. <sup>18</sup>F-fluorodeoxyglucose (FDG) is the most common PET-CT radiotracer used in the urology field. FDG PET-CT has a lower sensitivity compared to enhanced CT for primary diagnosis of renal masses. However, <sup>18</sup>F-Sodium fluoride PET-CT may have an advantage over conventional modalities in bone and musculoskeletal metastases. It is more sensitive at detecting RCC skeletal metastases than bone scintigraphy or CT.<sup>71,72</sup> **Currently, PET-CT is not a standard exam for diagnosis, staging, or surveillance in RCC.**

#### Recurrence patterns for pT1 tumours (low-risk)

Cohort studies have shown less than 7% of patients develop recurrences. The mean time to recurrence is 56 months and almost half of all recurrences are detected beyond five years following RN.<sup>73,74</sup> Among several series, the local recurrence for T1 lesions is approximately 2%. Local recurrence is more common for larger tumours following PN or tumour ablation compared to RN.

A population-based study showed occurrence of metastases or local recurrence in 5% of patients with T1a and 15% for T1b during five years of followup after RN or PN. The incidence of distant metastases was higher than local recurrence, regardless of surgical approach. Concerning all stages of RCC, the most common locations of the first recurrence were lung (54%), lymph nodes (22%), bone (20%), and liver (15%).<sup>75</sup> Other population-based studies have found similar results.<sup>76</sup> Chin et al<sup>77</sup> reported that tumour stage plays an important role in timing of recurrence, with T1 tumours generally recurring between three and four years following resection.

Similarly, a Canadian group has shown that median time to recurrence was 35 months (range 2–93) and only 0.9% had asymptomatic, isolated abdominal relapse at 13, 66, and 93 months postoperatively.<sup>78</sup> Lam et al reported that following nephrectomy, median time to recurrence was 28.9 months (mean  $\pm$  standard deviation [SD] 26.5 $\pm$ 17.1); the median time for chest and abdominal recurrence was 23.6 and 32 months, respectively.<sup>79</sup> Among several studies regarding RCC surveillance, the latest post-nephrectomy recurrence in the lungs, abdomen, and bone was approximately six, eight, and 12 years, respectively.<sup>75-78</sup> In a cohort from a single centre, most kidney cancer patients treated for lung metastasis were diagnosed with metachronous lesions with the following fea-

tures: solitary mass, one affected lung, and measured more than 2 cm. Multivariate analysis confirmed a significant effect of radical surgery on the survival in these patients.<sup>80</sup> Unlike metastases to the abdomen and thorax, metastases to brain and bone were symptomatic in 98.2% and 90.5%, respectively. These lesions become symptomatic quickly.<sup>81</sup>

In general, late recurrence beyond five years after nephrectomy for localized RCC can occur in 2–10% of patients, and in some cases after nine years from the initial treatment. Most recurrences are distant rather than local.<sup>82–84</sup> The largest study evaluating relapse after five years following nephrectomy demonstrated lymphovascular invasion, Fuhrman grade 3 or 4, and pathological tumour stage >pT1 as independent predictors of late recurrence. In addition, late recurrence was approximately 2.6%, 5%, 9%, 10%, 11%, and 22% for T1a, T1b, T2a, T2b, T3a, and T3b, respectively.<sup>82</sup>

Regarding nephron-sparing surgery for RCC, a retrospective study showed 5.1% recurrence rate (2.7% pT1a and 12.7% pT1b); 61% of relapses were diagnosed within the first 24 months following surgery (median time to relapse was 14.3 months). Multifocal or bilateral lesions and pathological stage higher than T1a were independent predictors of relapse on multivariate competing risk regression analysis.<sup>36</sup>

**Recommended surveillance (Table 1) will include blood biochemistry and CXR annually following surgery. Abdominal CT, MRI, or ultrasound (US) is recommended at 24 and 60 months (Level 4 evidence, Grade C recommendation). US**

is less sensitive than CT, however, its use is justifiable and cost-effective in patients with a minimal risk of abdominal recurrence and lower body mass index (BMI). **Followup is the same for PN for lesions <4 cm, since the local recurrence rates in this population are similar to RN (Level 2 evidence, Grade B recommendation). CT abdomen at 3–12 months postoperative for patients treated with PN to evaluate the residual baseline renal appearance is optional (Level 4 evidence, Grade C recommendation). Radiographical screening for brain and bone metastases is not recommended in asymptomatic patients (Level 4 evidence; Grade C recommendation). Routine imaging beyond five years is optional and can be risk-adapted (Grade D recommendation).**

### Recurrence patterns for pT2 tumours (intermediate-risk)

Several series have reported recurrences after a mean time of 24–35 months (range 1–82).<sup>73–75</sup> Dabestani et al<sup>75</sup> reported 35% recurrence rate after mean followup duration of five years in a population-based study of patients with T2 disease who underwent RN or PN. Retrospective analysis of single institution with similar followup showed 16% of recurrence, diagnosed between 24 and 57 months after RN, and the lung was the main site of recurrence.<sup>85</sup> The Canadian group reported a median time to recurrence of 25 months (range 3–95) and 50% were asymptomatic.<sup>78</sup> Lam et al showed that median time to recurrence was 17.8 months (mean ± SD

**Table 1. Followup post-surgical resection**

Months postop	3	6	12	18	24	30	36	48	60
Low-risk (pT1)									
Hx & PE			x		x		x	x	x
Blood test			x		x		x	x	x
CXR			x		x		x	x	x
Abdominal CT/MRI/US					x				x
Intermediate-risk (pT2)									
Hx & PE		x	x	x	x	x	x	x	x
Blood test		x	x	x	x	x	x	x	x
CXR or Chest CT		x	x	x	x	x	x	x	x
Abdominal CT/MRI/US			x		x		x		x
High-risk (pT3-4)*									
Hx & PE		x	x	x	x	x	x	x	x
Blood test		x	x	x	x	x	x	x	x
CXR or Chest CT		x	x	x	x	x	x	x	x
Abdominal CT/MRI		x	x	x	x		x		x
Very high-risk* (pTxN+)									
Hx & PE	x	x	x	x	x	x	x	x	x
Blood test	x	x	x	x	x	x	x	x	x
CXR or Chest CT	x	x	x	x	x	x	x	x	x
Abdominal CT/MRI	x	x	x	x	x	x	x	x	x

\*For high- and very high-risk patients, consider an extended individualized followup beyond 60 months (refer to text for more details). Blood tests: include blood count, serum chemistries, and liver function test. CXR: can be alternated with chest CT. Low-risk: baseline CT at 3–12 months post-partial nephrectomy is optional. **For ablation in cT1a tumours, surveillance is similar to low-risk disease except for abdominal CT/MRI at 3, 6, 12 months, then annually for up to 5 years.** If patient is symptomatic or abnormal blood test, earlier radiological investigations may be indicated. CT: computed tomography; CXR: chest x-ray; HX & PE: history and physical examination; MRI: magnetic resonance imaging.

25.5±23.9).<sup>79</sup> Among several studies regarding RCC surveillance, the latest post-nephrectomy recurrence in the lungs, abdomen, and bones was approximately eight years, eight years, and twelve years, respectively.<sup>75-78</sup> **Recommended surveillance (Table 1) will include clinical assessment, blood biochemistry, and CXR (or chest CT) every six months for three years, then yearly. Abdominal CT, MRI, or US recommended at 12, 24, 36, and 60 months (Level 4 evidence, Grade C recommendation).** Routine imaging beyond five years is at the discretion of the treating physician.

### Recurrence patterns for pT3/pT4 tumours and N+ (high-risk)

The median time to recurrence in this cohort is approximately 21 months (range 2–101).<sup>73</sup> Dabestani et al reported recurrence rates of 42% and 47% for patients with T3 and T4 disease, respectively.<sup>75</sup> Tumours classified as T3 generally recurred between 17 and 28 months.<sup>77</sup> Lam et al presented in this group that median time to recurrence was 9.5 months (mean ± SD 21.9±26.2).<sup>79</sup> Stewart et al reported 28% of patients developed recurrence after a median of 13.9 months (range 10–68.3).<sup>86</sup> In a multi-institutional cohort of 176 patients with pathological T3 disease (pT3), 26% of patients developed recurrence (24% of patients developed metastatic disease and 2% of patients developed an isolated local recurrence) after median followup 22.6 months (range 0.2–75). Lung (70%), bone (39%), and lymph nodes (30%) were the most common sites of metastases.<sup>87</sup> The recurrence rate for these group of patients was 15%, 30%, and 53% within one, three, and five years.<sup>88</sup> Among several studies regarding RCC surveillance, the latest post-nephrectomy recurrence in the lungs, abdomen, and bone was approximately twelve, six, and five years, respectively.<sup>75-78</sup> The presence of lymph node metastases is associated with dismal prognosis,<sup>89</sup> with a median survival of only 20.4 months.<sup>90</sup> **Recommended surveillance (Table 1) will include clinical assessment, blood biochemistry, and CXR (or chest CT) within three months after surgery and every six months for three years, and then yearly. Abdominal CT or MRI is recommended at 6, 12, 18, 24, 36, and 60 months, then every two years (Level 4 evidence, Grade C recommendation). In cases of lymph node-positive disease, abdominal CT or MRI is recommended at three and six months, then every six months for three years, then yearly (Level 4 evidence, Grade C recommendation).**

### Followup after ablation

Ablation is an option to treat selected patients with small renal mass, usually patients with clinical T1a RCC. There are several settings where ablation can be an option or recommended, such as patients with high surgical risk, complex mass in a solitary kidney, prior PN, and multifo-

cal, bilateral RCC, or patient preference.<sup>91,92</sup> Patients who have undergone ablation therapy due to RCC should be followed with contrast-enhanced radiological imaging (MRI or CT) to assess for residual enhancing disease and post-procedure complications. The success of this procedure is defined by two types of imaging findings, which are related to the zones of decreased perfusion, and the signal intensity (at MRI imaging) or attenuation (at CT).<sup>93</sup> An ablated tumour may be larger than the pre-treatment size in the imaging promptly performed after the procedure due to extension of treatment beyond its margin. After thermal ablation, the zone of ablation is usually seen as an area of hypoattenuation on CT and is generally hypointense at T2-weighted MRI and iso- to hyperintense at T1-weighted imaging relative to renal parenchyma. The ablation zone frequently involutes over time. Residual tumour after thermal ablation is most common at the margin of the ablation zone and often seen as nodular or crescent-shaped areas of contrast enhancement.<sup>94</sup> Renal tumours successfully treated with radiofrequency ablation (RFA) demonstrate no contrast enhancement. However, they do not regress significantly in size.<sup>95</sup> Meanwhile, renal tumours successfully treated with cryoablation may demonstrate reduction in size or complete resolution or scar formation.<sup>93</sup> Definition of successful after RFA for small renal masses based only on radiographical imaging has provoked some debate. Nevertheless, radiological imaging has remained the main tool to follow patients after ablation therapy. Meta-analysis evaluating cryoablation and RFA showed local tumour recurrence in 13% of patients, and 2% of patients developed metastasis.<sup>96</sup> In a cohort of cT1a patients treated with RFA demonstrated, a good response was seen in 74% of patients, whereas 8% had partial response and 18% failed response within mean 30.6 months of followup (range 4–60).<sup>97</sup> Large, single-centre series have shown failure rates of approximately 10% to cryoablation and RFA.<sup>98,99</sup> Several series have shown post-operative complications after ablation to treat RCC, ranging from 11–23% (**Level 3 evidence**).<sup>100-102</sup> Matin et al reviewed treatment and followup information of 616 patients who underwent RFA or cryoablation for renal masses from seven institutions and reported that most incomplete treatments (70%) were detected within the first three months following treatment.<sup>103</sup> **Recommended surveillance for ablated cT1a lesions (Table 1) will include clinical assessment, blood biochemistry, abdominal imaging (CT or MRI) at three, six, and 12 months, then annually thereafter for up to five years. CXR is recommended annually during followup (Level 4 evidence, Grade C recommendation). If pre-treatment biopsy demonstrated oncocytoma and imaging post-ablation shows treatment success, routine imaging beyond one year is not recommended (Level 5 evidence, Grade D recommendation).**

**Competing interests:** Dr. Kassouf has received grants/honoraria from Astellas, AstraZeneca, Janssen, Merck, and Roche. Dr. Fairey has been a speaker for J&J and Roche. Dr. Finelli has attended advisory boards for AbbVie, Amgen, Astellas, Bayer, Janssen, Roche, and Sanofi. Dr. Kapoor has attended advisory boards for and participated in clinical trials supported by Amgen, Astellas, GSK, Janssen, Novartis, Pfizer, and Sanofi. Dr. Lattouf has attended advisory boards AbbVie, Amgen, Astellas, Novartis, and Pfizer; and has received an educational grant from Janssen. Dr. Leveridge has attended advisory boards for Astellas. Dr. Power has participated in clinical trials supported by Argos Therapeutics. Dr. Pouliot has attended advisory boards for, Amgen, Astellas, and Pfizer; has been a speaker for Sanofi; has received payment/grants/honoraria from Amgen, Astellas, AstraZeneca, Janssen, Pfizer, and Sanofi. Dr. So has been a speaker for Amgen, Astellas, and Janssen. Dr. Tanguay has attended advisory boards for Pfizer; and has received travel grants from Sanofi. The remaining authors report no competing personal or financial interests.

This paper has been peer-reviewed.

## References

- Siegel RL, Miller KD, Jemal A. Cancer statistics, 2016. *CA Cancer J Clin* 2016;66:7-30. <https://doi.org/10.3322/caac.21332>
- Lucca I, Klatte T, Fajkovic H, et al. Gender differences in incidence and outcomes of urothelial and kidney cancer. *Nat Rev Urol* 2015;12:585-92. <https://doi.org/10.1038/nrurol.2015.232>
- Qayyum T, Oades G, Horgan P, et al. The epidemiology and risk factors for renal cancer. *Curr Urol* 2013;6:169-74. <https://doi.org/10.1159/000343534>
- Chow WH, Dong LM, Devesa SS. Epidemiology and risk factors for kidney cancer. *Nat Rev Urol* 2010;7:245-57. <https://doi.org/10.1038/nrurol.2010.46>
- Macleod LC, Hotaling JM, Wright JL, et al. Risk factors for renal cell carcinoma in the VITAL study. *J Urol* 2013;190:1657-61. <https://doi.org/10.1016/j.juro.2013.04.130>
- Sanfilippo KM, McTigue KM, Fidler CJ, et al. Hypertension and obesity and the risk of kidney cancer in two large cohorts of U.S. men and women. *Hypertension* 2014;63:934-41. <https://doi.org/10.1161/HYPERTENSIONAHA.113.02953>
- Tuong LD, Krishnan B, Cao JT, et al. Renal neoplasm in acquired cystic kidney disease. *Am J Kidney Dis* 1995;26:1-12. [https://doi.org/10.1016/0272-6386\(95\)90146-9](https://doi.org/10.1016/0272-6386(95)90146-9)
- Mariusdottir E, Ingimarsson JP, Jansson E, et al. Occupation as a risk factor for renal cell cancer: A nationwide, prospective, epidemiological study. *Scan J Urol* 2016;50:181-5. <https://doi.org/10.3109/21681805.2016.1151460>
- Karami S, Boffetta P, Stewart PS, et al. Occupational exposure to dusts and risk of renal cell carcinoma. *Br J Cancer* 2011;104:1797-803. <https://doi.org/10.1038/bjc.2011.148>
- Chittiboia P, Lonsler RR. Von Hippel-Lindau disease. *Handb Clin Neurol* 2015;132:139-56. <https://doi.org/10.1016/B978-0-444-62702-5.00010-X>
- Yap NY, Rajandram R, Ng KL, et al. Genetic and chromosomal aberrations and their clinical significance in renal neoplasms. *Biomed Res Int* 2015;2015:476508. <https://doi.org/10.1155/2015/476508>
- Adeniran AJ, Shuc B, Humphrey PA. Hereditary renal cell carcinoma syndromes: Clinical, pathological, and genetic features. *Am J Surg Pathol* 2015;39:e1-e18. <https://doi.org/10.1097/PAS.0000000000000562>
- Linehan WM. Genetic basis of kidney cancer: Role of genomics for the development of disease-based therapeutics. *Genome Res* 2012;22:2089-100. <https://doi.org/10.1101/gr.131110.111>
- Byler TK, Bratslavsky G. Hereditary renal cell carcinoma: Genetics, clinical features, and surgical considerations. *World J Urol* 2014;32:623-30. <https://doi.org/10.1007/s00345-014-1287-4>
- Zini L, Perrotte P, Jeldres C, et al. A population-based comparison of survival after nephrectomy vs. non-surgical management for small renal masses. *BJU Int* 2009;103:899-904. <https://doi.org/10.1111/j.1464-410X.2008.08247.x>
- Pierorazio PM, Johnson MH, Patel HD, et al. Management of renal masses and localized renal cancer: Systematic review and meta-analysis. *J Urol* 2016;196:989-99. <https://doi.org/10.1016/j.juro.2016.04.081>
- Van Poppel H, De Pozzo L, Albrecht W, et al. A prospective, randomised EORTC intergroup phase 3 study comparing the oncological outcome of elective nephron-sparing surgery and radical nephrectomy for low-stage renal cell carcinoma. *Eur Urol* 2011;59:543-52. <https://doi.org/10.1016/j.eururo.2010.12.013>
- Tan HJ, Norton EC, Ye Z, et al. Long-term survival following partial vs. radical nephrectomy among older patients with early-stage kidney cancer. *JAMA* 2012;307:1629-35. <https://doi.org/10.1001/jama.2012.475>
- Skolarikos A, Alivizatos G, Laguna P, et al. A review on followup strategies for renal cell carcinoma after nephrectomy. *Eur Urol* 2007;51:1490-500. <https://doi.org/10.1016/j.eururo.2006.12.031>
- University of Oxford, Graduate School in EBM and Research Methods, Centre for Evidence-based Medicine – Levels of Evidence 2009. Produced by Bob Phillips, Chris Ball, Dave Sackett, Doug Badenoch, Sharon Straus, Brian Haynes, Martin Dawes since November 1998. Updated by Jeremy Howick March 2009. <http://www.cebm.net/index.aspx?o=1025>. Accessed July 1, 2017.
- Kates M, Badalato GM, McKiernan JM. Renal functional outcomes after surgery for renal cortical tumours. *Curr Opin Urol* 2011;21:351-5. <https://doi.org/10.1097/MOU.0b013e32834962e9>
- Go AS, Chertow GM, Fan D, et al. Chronic kidney disease and the risk of death, cardiovascular events, and hospitalization. *N Engl J Med* 2004;351:1296-305. <https://doi.org/10.1056/NEJMoa041031>
- Inker LA, Astor BC, Fox CH, et al. KDOQI US commentary on the 2012 KDIGO clinical practice guideline for the evaluation and management of CKD. *Am J Kidney Dis* 2014;63:713-35. <https://doi.org/10.1053/j.ajkd.2014.01.416>
- Huang WC, Levey AS, Serio AM, et al. Chronic kidney disease after nephrectomy in patients with renal cortical tumours: A retrospective cohort study. *Lancet Oncol* 2006;7:735-40. [https://doi.org/10.1016/S1470-2045\(06\)70803-8](https://doi.org/10.1016/S1470-2045(06)70803-8)
- Mashni JW, Assel M, Maschino A, et al. New chronic kidney disease and overall survival after nephrectomy for small renal cortical tumours. *Urology* 2015;86:1137-43. <https://doi.org/10.1016/j.urology.2015.07.046>
- Clark MA, Shikanov S, Raman JD, et al. Chronic kidney disease before and after partial nephrectomy. *J Urol* 2011;185:43-8. <https://doi.org/10.1016/j.juro.2010.09.019>
- Rendon RA, Mason R, Kapoor A, et al. The natural history of renal function after surgical management of renal cell carcinoma: Results from the Canadian Kidney Cancer Information System. *Urol Oncol* 2016;34:486.e1-7. <https://doi.org/10.1016/j.urolonc.2016.05.025>
- Chung JS, Son NH, Byun SS, et al. Trends in a renal function after radical nephrectomy: A multicentre analysis. *BJU Int* 2014;113:408-15. <https://doi.org/10.1111/bju.12277>
- Finelli A, Ismail N, Bro B, et al. Management of small renal masses: American Society of Clinical Oncology clinical practice guideline. *J Clin Oncol* 2017;35:668-80. <https://doi.org/10.1200/JCO.2016.69.9645>
- Chronic Kidney Disease Prognosis Consortium, Matsushita K, van der Velde M, Astor BC, et al. Association of estimated glomerular filtration rate and albuminuria with all-cause and cardiovascular mortality: A collaborative meta-analysis of general population cohorts: A collaborative meta-analysis. *Lancet* 2010;375:2073-81. [https://doi.org/10.1016/S0140-6736\(10\)60674-5](https://doi.org/10.1016/S0140-6736(10)60674-5)
- Pettus JA, Jang TL, Thompson RH, et al. Effect of baseline glomerular filtration rate on survival in patients undergoing partial or radical nephrectomy for renal cortical tumours. *Mayo Clin Proc* 2008;83:1101-6. <https://doi.org/10.4065/83.10.1101>
- Brenner DJ, Hall EJ. Computed tomography — an increasing source of radiation exposure. *N Engl J Med* 2007;357:2277-84. <https://doi.org/10.1056/NEJMra072149>
- Chang SL, Cipriano LE, Harshman LC, et al. Cost-effectiveness analysis of nephron-sparing options for the management of small renal masses. *J Urol* 2011;185:1591-7. <https://doi.org/10.1016/j.juro.2010.12.100>
- Marconi L, Gorin MA, Allaf ME. Post-partial nephrectomy surveillance imaging: An evidence-based approach. *Curr Urol Rep* 2015;16:23. <https://doi.org/10.1007/s11934-015-0489-7>
- Lipsky MJ, Shapiro EY, Hruby GW, et al. Diagnostic radiation exposure during surveillance in patients with pT1a renal cell carcinoma. *Urology* 2013;81:1190-5. <https://doi.org/10.1016/j.urology.2012.08.056>
- Zargar-Shostari K, Kim T, Simon R, et al. Surveillance following nephron-sparing surgery: An assessment of recurrence patterns and surveillance costs. *Urology* 2015;86:321-6. <https://doi.org/10.1016/j.urology.2015.05.013>
- Bani-Hani AH, Leibovich BC, Loshe CM, et al. Associations with contralateral recurrence following nephrectomy for renal cell carcinoma using a cohort of 2352 patients. *J Urol* 2005;173:391-4. <https://doi.org/10.1097/01.ju.0000148951.71353.8b>
- Chow JJ, Ahmed K, Fazili Z, et al. Solitary renal fossa recurrence of renal cell carcinoma after nephrectomy. *Rev Urol* 2014;16:76-82.
- Thomas AZ, Adibi M, Borregales LD, et al. Surgical management of local retroperitoneal recurrence of renal cell carcinoma after radical nephrectomy. *J Urol* 2015;194:316-22. <https://doi.org/10.1016/j.juro.2015.02.2943>
- Kapoor A, Bansal RK, Tanguay S, et al. Positive surgical margins during partial nephrectomy for renal cell carcinoma: Results from Canadian Kidney Cancer information system (CKCis) collaborative. *Can Urol Assoc J* 2017;11:182-7. <https://doi.org/10.5489/auoj.4264>
- Psutka SP, Heidenreich M, Boorjian SA, et al. Renal fossa recurrence after nephrectomy for renal cell carcinoma: Prognostic features and oncological outcomes. *BJU Int* 2017;119:116-27. <https://doi.org/10.1111/bju.13620>

42. Paparel P, Bigot P, Matillon X, et al. Local recurrence after radical nephrectomy for kidney cancer: Management and prediction of outcomes. A multi-institutional study. *J Surg Oncol* 2014;109:126-31. <https://doi.org/10.1002/jso.23473>
43. Margulis V, McDonald M, Tamboli P, et al. Predictors of oncological outcome after resection of locally recurrent renal cell carcinoma. *J Urol* 2009;181:2044-51. <https://doi.org/10.1016/j.juro.2009.01.043>
44. Volpe A, Patard JJ. Prognostic factors in renal cell carcinoma. *World J Urol* 2010;28:319-27. <https://doi.org/10.1007/s00345-010-0540-8>
45. Sun M, Shariat SF, Cheng C, et al. Prognostic factors and predictive models in renal cell carcinoma: A contemporary review. *Eur Urol* 2011;60:644-61. <https://doi.org/10.1016/j.euro.2011.06.041>
46. Lee HW, Jeon HG, Jeong BC, et al. Diagnostic and prognostic significance of radiologic node-positive renal cell carcinoma in the absence of distant metastases: A retrospective analysis of patients undergoing nephrectomy and lymph node dissection. *J Korean Med Sci* 2015;30:1321-7. <https://doi.org/10.3346/jkms.2015.30.9.1321>
47. Borregales LD, Kim DY, Staller AL, et al. Prognosticators and outcomes of patients with renal cell carcinoma and adjacent organ invasion treated with radical nephrectomy. *Urol Oncol* 2016;34:237.e19-26. <https://doi.org/10.1016/j.urolonc.2015.11.020>
48. Nguyen DP, Vertosick EA, Corradi RB, et al. Histological subtype of renal cell carcinoma significantly affects survival in the era of partial nephrectomy. *Urol Oncol* 2016;34:259.e1-8. <https://doi.org/10.1016/j.urolonc.2016.01.005>
49. Patard JJ, Leray E, Rioux-Leclercq N, et al. Prognostic value of histologic subtypes in renal cell carcinoma: A multicenter experience. *J Clin Oncol* 2005;23:2763-71. <https://doi.org/10.1200/JCO.2005.07.055>
50. Ljungberg B, Bensalah K, Canfield S, et al. EAU guidelines on renal cell carcinoma: 2014 update. *Eur Urol* 2015;67:913-24. <https://doi.org/10.1016/j.euro.2015.01.005>
51. Fuhrman SA, Lasky LC, Limas C. Prognostic significance of morphologic parameters in renal cell carcinoma. *Am J Surg Pathol* 1982;6:655-63. <https://doi.org/10.1097/0000478-198210000-00007>
52. Delahunt B, Sika-Paotonu D, Bethwaite PB, et al. Grading of clear cell renal cell carcinoma should be based on nucleolar prominence. *Am J Surg Pathol* 2011;35:1134-9. <https://doi.org/10.1097/PAS.0b013e318220697f>
53. Lang H, Lindner V, de Fromont M, et al. Multicentre determination of optimal interobserver agreement using the Fuhrman grading system for renal cell carcinoma: Assessment of 241 patients with >15-year followup. *Cancer* 2005;103:625-9. <https://doi.org/10.1002/cncr.20812>
54. Patard JJ, Leray E, Cindolo L, et al. Multi-institutional validation of a symptom-based classification for renal cell carcinoma. *J Urol* 2004;172:858-62. <https://doi.org/10.1097/01.ju.0000135837.64840.55>
55. Kim HL, Han KR, Zisman A, et al. Cachexia-like symptoms predict a worse prognosis in localized T1 renal cell carcinoma. *J Urol* 2004;171:1810-3. <https://doi.org/10.1097/01.ju.0000121440.82581.d3>
56. Kim HL, Belldegrun AS, Freitas DG, et al. Paraneoplastic signs and symptoms of renal cell carcinoma: Implications for prognosis. *J Urol* 2003;170:1742-6. <https://doi.org/10.1097/01.ju.0000092764.81308.6a>
57. Bensalah K, Leray E, Fergelot P, et al. Prognostic value of thrombocytosis in renal cell carcinoma. *J Urol* 2006;175:859-63. [https://doi.org/10.1016/S0022-5347\(05\)00526-4](https://doi.org/10.1016/S0022-5347(05)00526-4)
58. Golovastova MO, Korolev DO, Tsoy LV, et al. Biomarkers of renal tumours: The current state and clinical perspectives. *Curr Urol Rep* 2017;18:3. <https://doi.org/10.1007/s11934-017-0655-1>
59. Poste G. Bring on the biomarkers. *Nature* 2011;469:156-7. <https://doi.org/10.1038/469156a>
60. Sim SH, Messenger MP, Gregory WM, et al. Prognostic utility of preoperative circulating osteopontin, carbonic anhydrase IX, and CRP in renal cell carcinoma. *Br J Cancer* 2012;107:1131-7. <https://doi.org/10.1038/bjc.2012.360>
61. Tan PH, Cheng L, Rioux-Leclercq N, et al. Renal tumours: Diagnostic and prognostic biomarkers. *Am J Surg Pathol* 2013;37:1518-31. <https://doi.org/10.1097/PAS.0b013e318299f12e>
62. Ngo TC, Wood CG, Karam JA. Biomarkers of renal cell carcinoma. *Urol Oncol* 2014;32:243-51. <https://doi.org/10.1016/j.urolonc.2013.07.011>
63. Patard JJ, Kim HL, Lam JS, et al. Use of the University of California Los Angeles integrated staging system to predict survival in renal cell carcinoma: An international, multicentre study. *J Clin Oncol* 2004;22:3316-22. <https://doi.org/10.1200/JCO.2004.09.104>
64. Barbieri CE, Chinnaiyan AM, Lerner SP, et al. The emergence of precision urologic oncology: A collaborative review on biomarker-driven therapeutics. *Eur Urol* 2011;71:237-46. <https://doi.org/10.1016/j.euro.2016.08.024>
65. Iacovelli R, Nolè F, Verri E, et al. Prognostic role of PD-L1 expression in renal cell carcinoma. A systematic review and meta-analysis. *Target Oncol* 2016;11:143-8. <https://doi.org/10.1007/s11523-015-0392-7>
66. Patard JJ, Kim HL, Lam JS, et al. Use of the University of California Los Angeles integrated staging system to predict survival in renal cell carcinoma: An international, multicentre study. *J Clin Oncol* 2004;22:3316-22. <https://doi.org/10.1200/JCO.2004.09.104>
67. Zisman A, Pantuck AJ, Dorey F, et al. Improved prognostication of renal cell carcinoma using an integrated staging system. *J Clin Oncol* 2001;19:1649-57. <https://doi.org/10.1200/JCO.2001.19.6.1649>
68. Zigeuner R, Hutterer G, Chromecki T, et al. External validation of the Mayo Clinic stage, size, grade, and necrosis (SSIGN) score for clear-cell renal cell carcinoma in a single European centre applying routine pathology. *Eur Urol* 2010;57:102-9. <https://doi.org/10.1016/j.euro.2008.11.033>
69. Karakiewicz PI, Briganti A, Chun FK, et al. Multi-institutional validation of a new renal cancer-specific survival nomogram. *J Clin Oncol* 2007;25:1316-22. <https://doi.org/10.1200/JCO.2006.06.1218>
70. Platzek I, Zastrow S, Deppe PE, et al. Whole-body MRI in followup of patients with renal cell carcinoma. *Acta Radiol* 2010;51:581-9. <https://doi.org/10.3109/02841851003724846>
71. Gofrit ON, Orevi M. Diagnostic challenges of kidney cancer: A systematic review of the role of positron emission tomography-computerized tomography. *J Urol* 2016;196:648-57. <https://doi.org/10.1016/j.juro.2016.02.2992>
72. Gerety EL, Eisen T, Gallagher FA, et al. Prospective study evaluating the relative sensitivity of 18F-NaF PET/CT for detecting skeletal metastases from renal cell carcinoma in comparison to multidetector CT and 99mTc-MDP bone scintigraphy, using an adaptive trial design. *Ann Oncol* 2015;26:2113-8. <https://doi.org/10.1093/annonc/mdv289>
73. van Oostenbrugge TJ, Kroeze SG, Bosch JL, et al. The blind spots in followup after nephrectomy or nephron-sparing surgery for localized renal cell carcinoma. *World J Urol* 2015;33:881-7. <https://doi.org/10.1007/s00345-014-1390-6>
74. Leibovich BC, Blute ML, Cheville JC, et al. Prediction of progression after radical nephrectomy for patients with clear cell renal cell carcinoma: A stratification tool for prospective clinical trials. *Cancer* 2003;97:1663-71. <https://doi.org/10.1002/cncr.11234>
75. Dabestani S, Thorstenson A, Lindblad P, et al. Renal cell carcinoma recurrences and metastases in primary non-metastatic patients: A population-based study. *World J Urol* 2016;34:1081-6. <https://doi.org/10.1007/s00345-016-1773-y>
76. Bianchi M, Sun M, Jeldres C, et al. Distribution of metastatic sites in renal cell carcinoma: A population-based analysis. *Ann Oncol* 2012;23:973-80. <https://doi.org/10.1093/annonc/mdr362>
77. Chin AI, Lam JS, Figlin RA, et al. Surveillance strategies for renal cell carcinoma patients following nephrectomy. *Rev Urol* 2006;8:1-7.
78. Stephenson AJ, Chetner MP, Rourke K, et al. Guidelines for the surveillance of localized renal cell carcinoma based on the patterns of relapse after nephrectomy. *J Urol* 2004;172:58-62. <https://doi.org/10.1097/01.ju.0000132126.85812.7d>
79. Lam JS, Shvarts O, Leppert JT, et al. Postoperative surveillance protocol for patients with localized and locally advanced renal cell carcinoma based on a validated prognostic nomogram and risk group stratification system. *J Urol* 2005;174:466-72. <https://doi.org/10.1097/01.ju.0000165572.38887.da>
80. Matveev VB, Volkova MI, Turkin IN, et al. Surgical treatment of lung metastases of kidney cancer. *Urologia* 2013;Jan-Feb:63-8.
81. Siddiqui SA, Frank I, Cheville JC, et al. Postoperative surveillance for renal cell carcinoma: A multifactorial, histological subtype-specific protocol. *BJU Int* 2009;104:778-85. <https://doi.org/10.1111/j.1464-410X.2009.08499.x>
82. Brookman-May S, May M, Shariat SF, et al; Members of the CORONA project and the SATURN project. Features associated with recurrence beyond five years after nephrectomy and nephron-sparing surgery for renal cell carcinoma: Development and internal validation of a risk model (PRELANE score) to predict late recurrence based on a large, multicentre database (CORONA/SATURN Project). *Eur Urol* 2013;64:472-7. <https://doi.org/10.1016/j.euro.2012.06.030>
83. Kim SP, Weight CJ, Leibovich BC, et al. Outcomes and clinicopathological variables associated with late recurrence after nephrectomy for localized renal cell carcinoma. *Urology* 2011;78:1101-6. <https://doi.org/10.1016/j.urol.2011.05.012>
84. Adamy A, Chong KT, Chade D, et al. Clinical characteristics and outcomes of patients with recurrence five years after nephrectomy for localized renal cell carcinoma. *J Urol* 2011;185:433-8. <https://doi.org/10.1016/j.juro.2010.09.100>
85. Kwon SY, Jung JW, Kim BS, et al. Laparoscopic vs. open radical nephrectomy in T2 renal cell carcinoma: Long-term oncological outcomes. *Korean J Urol* 2011;52:474-8. <https://doi.org/10.4111/kju.2011.52.7.474>
86. Stewart GD, Ang WJ, Laird A, et al. The operative safety and oncological outcomes of laparoscopic nephrectomy for T3 renal cell cancer. *BJU Int* 2012;110:884-90. <https://doi.org/10.1111/j.1464-410X.2011.10850.x>
87. Nayak JG, Patel P, Bjaezvic J, et al. Clinical outcomes following laparoscopic management of pT3 renal masses: A large, multi-institutional cohort. *Can Urol Assoc J* 2015;9:397-402. <https://doi.org/10.5489/cuaj.2848>
88. Azawi NH, Tesfalem H, Mosholt KS, et al. Recurrence and survival in a Danish cohort with renal cell carcinoma. *Dan Med J* 2016;63.pii:A5208.
89. Capitanio U, Jeldres C, Patard JJ, et al. Stage-specific effect of nodal metastases on survival in patients with non-metastatic renal cell carcinoma. *BJU Int* 2009;103:33-7. <https://doi.org/10.1111/j.1464-410X.2008.08014.x>

90. Babaian KN, Kim DY, Kenney PA, et al. Preoperative predictors of pathological lymph node metastasis in patients with renal cell carcinoma undergoing retroperitoneal lymph node dissection. *J Urol* 2015;193:1101-7. <https://doi.org/10.1016/j.juro.2014.10.096>
91. Katsanos K, Mailli L, Krokidis M, et al. Systematic review and meta-analysis of thermal ablation vs. surgical nephrectomy for small renal tumours. *Cardiovasc Intervent Radiol* 2014;37:427-37. <https://doi.org/10.1007/s00270-014-0846-9>
92. Pierorazio PM, Johnson MH, Patel HD, et al. Management of renal masses and localized renal cancer: Systematic review and meta-analysis. *J Urol* 2016;196:989-99. <https://doi.org/10.1016/j.juro.2016.04.081>
93. Ahmed M, Solbiati L, Brace CL, et al. Image-guided tumour ablation: Standardization of terminology and reporting criteria — a 10-year update. *J Vasc Interv Radiol* 2014;25:1691-705. <https://doi.org/10.1016/j.jvir.2014.08.027>
94. Kawamoto S, Solomon SB, Bluemke DA, et al. Computed tomography and magnetic resonance imaging appearance of renal neoplasm after radiofrequency ablation and cryoablation. *Semin Ultrasound CT MR* 2009;30:67-77. <https://doi.org/10.1053/j.sult.2008.12.005>
95. Matsumoto ED, Watumull L, Johnson DB, et al. The radiographic evolution of radio frequency ablated renal tumours. *J Urol* 2004;172:45-8. <https://doi.org/10.1097/01.ju.0000132124.01060.0c>
96. Kunkle DA, Uzzo RG. Cryoablation or radiofrequency ablation of the small renal mass: A meta-analysis. *Cancer* 2008;113:2671-80. <https://doi.org/10.1002/cncr.23896>
97. Curry D, Yassin M, Thwaini A, et al. Radiofrequency ablation of renal cell carcinoma: A followup of outcomes. *Can J Urol* 2014;21:7135-40.
98. Tanagho YS, Roytman TM, Bhavani SB, et al. Laparoscopic cryoablation of renal masses: Single-centre, long-term experience. *Urology* 2012;80:307-14. <https://doi.org/10.1016/j.urol.2012.03.044>
99. Psutka SP, Feldman AS, McDougal WS, et al. Long-term oncological outcomes after radiofrequency ablation for T1 renal cell carcinoma. *Eur Urol* 2013;63:486-92. <https://doi.org/10.1016/j.eururo.2012.08.062>
100. Turdeau V, Larcher A, Boehm K, et al. Comparison of postoperative complications and mortality between laparoscopic and percutaneous local tumour ablation for T1a renal cell carcinoma: A population-based study. *Urology* 2016;89:63-7. <https://doi.org/10.1016/j.urol.2015.08.043>
101. McClure TD, Chow DS, Tan N, et al. Intermediate outcomes and predictors of efficacy in the radiofrequency ablation of 100 pathologically proven renal cell carcinomas. *J Vasc Interv Radiol* 2014;25:1682-8. <https://doi.org/10.1016/j.jvir.2014.06.013>
102. Atwell TD, Carter RE, Schmit GD, et al. Complications following 573 percutaneous renal radiofrequency and cryoablation procedures. *J Vasc Interv Radiol* 2012;23:48-54. <https://doi.org/10.1016/j.jvir.2011.09.008>
103. Marin SF, Ahrar K, Cadeddu JA, et al. Residual and recurrent disease following renal energy ablation therapy: A multi-institutional study. *J Urol* 2006;176:1973-7. <https://doi.org/10.1016/j.juro.2006.07.016>

**Correspondence:** Dr. Wassim Kassouf, Division of Urology, McGill University Health Centre, Montreal, QC, Canada; [wassim.kassouf@muhc.mcgill.ca](mailto:wassim.kassouf@muhc.mcgill.ca)

Come and celebrate the **10<sup>th</sup>** Anniversary of the  
**Princess Margaret Cancer Centre (PMCC)**  
**Uro-Oncology Dialogue**

September 14-16, 2018 • Queen's Landing, Niagara-on-the-Lake, ON

Tony Finelli & Munir Jamal, Program Co-Chairs  
 Neil Fleshner, Rob Hamilton, Nathan Perlis, Girish Kulkarni,  
 Alex Zlotta... and many more academic speakers from the PMCC

**Registration Fees**

Urologists: \$625  
 Fellows, Residents, Nurses: \$395  
 Accompanying Persons: \$285

**Accommodations**

Until August 15, 2018, book  
 your stay at a preferred rate  
 of \$269 per night.



REGISTER TODAY at [cuameeting.org](http://cuameeting.org)

[cuameeting.org](http://cuameeting.org)