Measuring quality care in localized renal cell cancer: use of appropriate preoperative investigations in a population-based cohort

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ABSTRACT

Introduction Obtaining appropriate preoperative risk-specific staging investigations for localized renal cell carcinoma (rcc) is a recognized quality indicator. The goal of the present work was to determine the use and appropriateness of preoperative investigations in patients undergoing curative surgery for rcc.

Methods This population-based retrospective study of patients having surgery for localized rcc recorded the use of preoperative imaging and laboratory investigations within 6 months of surgery. “Appropriate” stage-specific investigations were determined using recognized published guidelines.

Results The study cohort consisted of 544 patients with 72.8% being stage i, 18.4% being stage ii, and 8.8% being stage iii by clinical TNM (2002) criteria. In 61.6%, chest imaging was obtained by chest radiography or computed tomography (ct) within 3 months preoperatively; in 75.6%, such imaging was obtained within 6 months. Abdominal ct imaging was obtained in 97.1% of patients before surgery, with 77.5% of patients receiving such imaging within 3 months of surgery. Complete blood count, electrolytes, and creatinine were measured in 99.1% of patients, but those tests plus other recommended blood tests including calcium, alkaline phosphatase, and liver function were measured in only 17.7%.

Conclusions In this study, most patients received appropriate abdominal imaging, but chest imaging was underutilized in the overall cohort. Despite being recommended, blood tests such as liver function, alkaline phosphatase, and calcium were completed in fewer than 2 of 10 patients. This analysis provides the groundwork for quality improvement initiatives directed to the use of preoperative investigations in localized rcc.

Key Words Renal cell carcinoma, preoperative investigations, quality indicators

Curr Oncol. 2017 Apr;24(2):e152-e156 www.current-oncology.com

INTRODUCTION

Since the early 2000s, awareness about, and efforts to improve, the quality of care in oncology have increased. Quality of care is defined as the “degree to which health services for individuals and populations increases the likelihood of desired health outcomes and are consistent with current professional knowledge”¹. Ideally, measuring the quality of care is necessary to determine whether clinical benchmarks are reached, care is improved, and good value is obtained. Various methods to objectively measure quality of care are available, one of which is the development and use of quality indicators.

Renal cell carcinoma (rcc) is a cancer that is rising in incidence and prevalence; it has become a much more multidisciplinary, complex disease to manage²,³. Quality indicators have been well-established for many malignancies; however, none had been established for rcc until recently. In 2013, a group of Canadian rcc experts used a modified Delphi approach to define 21 quality indicators across the entire disease spectrum⁴. One of those quality indicators is “obtaining appropriate preoperative risk specific staging investigations for localized rcc”⁴.

Determining and reaching agreement on what constitutes “appropriate” investigations is difficult; no phase iii data or level 1 evidence exists. For the purposes of the
present work, “appropriate” preoperative imaging and laboratory investigations were based on the recommendations in guidelines published by the major players in the area, including the American Urological Association (AUA), the European Association of Urology, and the U.S. National Comprehensive Cancer Network (NCCN). Table 1 summarizes their guidelines.

In terms of imaging studies, all three guidelines recommend abdominal CT or magnetic resonance imaging (MRI) in the presence of renal insufficiency, contrast allergy, venous involvement, or locally invasive mass, plus head CT or bone scan in the presence of symptoms or elevated alkaline phosphatase. The guidelines differ with respect to chest imaging. Only the AUA guideline was risk-specific (for stage I RCC). It recommends chest radiography in all patients and chest CT only in the presence of symptoms or an abnormal chest radiograph. The European Association of Urology and NCCN guidelines are for stage I, II, and III patients combined. They recommend at least chest radiography, but indicate that chest CT is more accurate. Before 2015, the NCCN guidelines recommended either chest radiography or CT, and did not indicate a preference for one over the other.

In terms of preoperative blood work, the European Association of Urology guidelines are the most extensive, recommending a complete blood count (CBC), creatinine, liver function tests, alkaline phosphatase, erythrocyte sedimentation rate, lactate dehydrogenase, corrected calcium, coagulation studies, and a urinalysis. The NCCN guidelines recommend CBC, creatinine, liver function tests, corrected calcium, and a urinalysis, and the AUA guidelines specifically comment on liver function tests and alkaline phosphatase.

None of the identified guidelines is time sensitive—that is, there are no recommendations that address the ideal timeframe for the completion of staging investigations in relation to the time of surgery. Unspecified timeframes are true not only for RCC guidelines, but also for most cancer guidelines. Based on our own clinical judgment and input from urologists involved in the Quality Initiative of the Kidney Cancer Research Network of Canada, the consensus was that investigations should be performed within 3 months of curative surgery. We also collected data on investigations done within 6 months of surgery.

Thus, the primary objective of the present study was to determine the use and appropriateness of preoperative investigations in patients undergoing curative surgery for stage I, II, or III RCC.

**METHODS**

A population-based retrospective chart review considered all patients undergoing curative surgery for stage I, II, or III RCC in mainland Nova Scotia from January 2006 to December 2010. If, on chart review, a patient was determined to have stage IV disease, that patient was excluded. Appropriate research ethics board approval was obtained.

Patients were identified using Cancer Care Nova Scotia’s Surveillance and Epidemiology Registry. Data were collected using multiple sources of electronic health records (including Clinical Portal, Share, and Meditech for patient information, laboratory values, and radiologic imaging, as well as IMPAX and XERO for radiologic imaging).

The baseline demographics collected included age, presentation, type of surgery, and clinical TNM (2002)
staging. Date of kidney cancer diagnosis was recorded as the day that abdominal imaging first showed an abnormality consistent with kidney cancer. Preoperative investigations recorded included radiologic procedures (chest, abdomen, pelvis, bone, and brain imaging) and bloodwork (CBC, liver function tests, calcium, and creatinine). Information about which type of doctor ordered the imaging was also obtained.

Per Table I, “appropriate” chest imaging was defined as either chest radiography or chest CT, and appropriate abdominal imaging was defined as either abdominal CT or MRI. The AJCC guidelines indicate that chest radiography is appropriate for stage I disease. “Essential” laboratory investigations were defined as a CBC, electrolytes, and creatinine at minimum, but “appropriate” investigations were expected to include CBC, electrolytes, creatinine, liver function tests, alkaline phosphatase, and calcium.

Data were collected and recorded on a data collection sheet and entered into a Microsoft Access database (Redmond, WA, U.S.A.) by three of the investigators (NM, KHM, LAW). In all cases where investigations were deemed “inappropriate” (that is, investigations were not done within 6 months of surgery), all available electronic records were re-reviewed by the investigators (LAW, NM) to ensure data collection accuracy.

Analyses were performed using the SAS software application (version 9.3: SAS Institute, Cary, NC, U.S.A.). Continuous data are summarized as means with standard deviations or as medians with ranges, as appropriate. Categorical variables are summarized as frequencies and counts.

### RESULTS

During the period of interest, 544 patients underwent curative surgery for RCC. Men constituted 57.2% of the cohort, and median age at diagnosis was 62.6 years. Median time from diagnosis to surgery was 3.2 months. Partial nephrectomy was performed in 38.2% of patients, and radical nephrectomy in 61.8%. Patients most often presented with local symptoms including hematuria or flank pain (39.2%), followed by incidental findings on imaging studies (32.9%), abdominal symptoms (12.1%), systemic symptoms (5.7%), and other symptoms (10.1%). In this cohort, 72.8% of patients were stage I, 18.4% were stage II, and 8.8% were stage III.

Table II details the types of preoperative imaging studies completed. Chest radiography was performed in 62.5% of patients within 6 months of surgery and in 49.1% within 3 months of surgery. Chest CT was completed in 30.3% of patients within 6 months of surgery and in 24.1% within 3 months of surgery. The proportion of patients undergoing either chest radiography or chest CT was 75.6% within 6 months of surgery and 61.6% within 3 months.

Table II also details stage-specific chest imaging. Chest radiography was completed within 6 months of surgery in 60.4% of stage I, 66% of stage II, and 72.9% of stage III patients and within 3 months in 45.2% of stage I, 55% of stage II, and 68.8% of stage III patients. Chest CT was performed within 6 months of surgery in 25.8% of stage I, 43% of stage II, and 41.7% of stage III patients and within 3 months in 18.7% of stage I, 39.0% of stage II, and 37.5% of stage III patients. Any chest imaging was performed within 6 months of surgery in 72.5% of stage I, 83% of stage II, and 85.4% of stage III patients and within 3 months in 56.1% of stage I, 74% of stage II, and 81.3% of stage III patients.

In patients who underwent chest radiography, the imaging was ordered after the diagnosis of kidney cancer (true staging) in 77.5%, before the diagnosis in 16.9%, and on the same day as the diagnosis in 5.6%. In patients who underwent chest CT, the imaging was performed after the diagnosis (true staging) in 56.8%, before the diagnosis in 27.4%, and on the same day as the diagnosis in 10.5%.

Most patients (87.1%) underwent abdominal CT within 6 months of surgery, with 66.4% of the patients being imaged within 3 months. Other modalities of abdominal imaging included ultrasonography and MRI. Abdominal ultrasonography at any time before surgery was performed in 44.5% of patients. Within 6 months of surgery, ultrasonography was performed in 34.7% of patients, and within 3 months, in 21.5%. Abdominal MRI was performed in 10.1% of patients within 6 months of surgery, with no real difference between the stages: 11.9% for stage I, 4% for stage II, and 8.3% for stage III. A small proportion of patients

<table>
<thead>
<tr>
<th>Investigation</th>
<th>Patients (%) receiving the investigation</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>All (n=544)</td>
</tr>
<tr>
<td>Chest</td>
<td></td>
</tr>
<tr>
<td>Plain radiography</td>
<td>49.1</td>
</tr>
<tr>
<td>Within 3 months</td>
<td>62.5</td>
</tr>
<tr>
<td>CT</td>
<td></td>
</tr>
<tr>
<td>Within 3 months</td>
<td>24.1</td>
</tr>
<tr>
<td>Within 6 months</td>
<td>30.3</td>
</tr>
<tr>
<td>Either radiography or CT</td>
<td>61.6</td>
</tr>
<tr>
<td>Within 3 months</td>
<td>75.6</td>
</tr>
<tr>
<td>Abdomen</td>
<td></td>
</tr>
<tr>
<td>Ultrasonography</td>
<td>21.5</td>
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<tr>
<td>Within 3 months</td>
<td>34.7</td>
</tr>
<tr>
<td>CT</td>
<td></td>
</tr>
<tr>
<td>Within 3 months</td>
<td>66.4</td>
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<tr>
<td>Within 6 months</td>
<td>87.1</td>
</tr>
<tr>
<td>MRI</td>
<td></td>
</tr>
<tr>
<td>Within 3 months</td>
<td>5.7</td>
</tr>
<tr>
<td>Within 6 months</td>
<td>10.1</td>
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<tr>
<td>CT or MRI</td>
<td></td>
</tr>
<tr>
<td>Within 3 months</td>
<td>68.9</td>
</tr>
<tr>
<td>Within 6 months</td>
<td>91.2</td>
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</tbody>
</table>

CT = computed tomography; MRI = magnetic resonance imaging.
received no abdominal CT or MRI, only ultrasonography. The benchmark of appropriate abdominal imaging—defined as abdominal MRI or CT within 3 months of surgery—was met in 68.9% of patients; 91.2% of patients had such imaging within 6 months. Bone scans were performed in 10.3% of patients at any given time before surgery.

Table III outlines the proportion of patients receiving the recommended preoperative laboratory investigations. More than 99% compliance was achieved for essential bloodwork (CBC, electrolytes, and creatinine); however, only 17.7% of patients received all the recommended bloodwork (CBC, creatinine, electrolytes, calcium, alkaline phosphatase, and liver function tests).

Table IV sets out data related to the type of doctor ordering chest imaging, together with the corresponding stage. In stage I disease, family physicians ordered a chest CT in 52.7% of cases (chest radiography in 22.9%), and urologists ordered a chest CT in 32.4% of cases (chest radiography in 66.5%). In stage II disease, family physicians ordered a chest CT in 59.0% of cases (chest radiography in 25%), and urologists ordered a chest CT in 28.2% of cases (chest radiography in 67.9%). In stage III disease, urologists and family physicians ordered similar proportions of chest radiography (43.8% and 40.6% respectively) and chest CT (44.4% and 33.3% respectively).

## DISCUSSION AND CONCLUSIONS

Preoperative investigations to accurately stage a patient are recommended before curative therapy. Staging provides information to help guide decisions about the goals of treatment, the treatment plan, and the overall prognosis.

In the cohort of patients examined here, 91.2% of patients underwent appropriate preoperative abdominal imaging within 6 months before surgery, and 68.9% within 3 months. However, similar data were not seen with chest imaging. Despite recommendations in all guidelines for some form of chest imaging, our results show an underutilization of chest imaging, with only 61.6% of patients receiving any chest imaging within 3 months of surgery. That finding implies that 2 of 5 patients receive no form of chest staging within the defined “ideal” timeframe. The proportion of patients who received chest imaging within 6 months of surgery was only marginally higher at 75.6%. Incomplete chest staging within 3 months of surgery was found across all stages of localized RCC, although the rate did vary from no staging in 44% of patients with stage I disease to 19% of patients with stage III disease.

Almost all patients undergoing curative surgery for RCC received basic laboratory investigations (CBC, electrolytes, and creatinine). However, only a small proportion of patients (17.7%) received a comprehensive laboratory work-up. The recommended investigations, such as alkaline phosphatase and calcium, were conducted in fewer than 1 of every 3 patients.

Despite a recognized quality indicator in RCC being to “obtain appropriate preoperative risk specific staging,” only the AUA guideline is specific for low-risk stage I RCC. The AUA has no guidelines on the initial work-up of stage II or III RCC that would allow for comparing and contrasting potential differences. We speculate that, given the low risk of metastases with stage I disease and the desire to minimize excess radiation exposure, the major difference would be to recommend chest radiography for stage I disease and chest CT for stage II and III disease. Chest CT
can be reserved for stage 1 patients with symptoms or an abnormal chest radiograph. Accepting that assumption, our results show more chest CT imaging ordered for stage I patients and less chest CT imaging ordered for stage II and III patients. Interestingly, family physicians were more likely than urologists to order chest CT imaging in stage I and II patients. However, given that 40.5% of chest CT imaging was performed on the same day as the radiologic diagnosis of kidney cancer, the suggestion would be that patient’s symptoms are being worked up with a complete chest and abdominal CT series rather than a chest CT being ordered as a specific staging investigation.

The limitations of our study include its retrospective nature. For completeness of data, chart reviews rely on accurate recordkeeping by all health care providers involved in the care of a patient. However, in terms of radiologic imaging, two specific provincial imaging databases were reviewed for each patient to ensure that the maximum amount of information was obtained, thus reducing the chance of missing radiologic studies. Furthermore, multiple electronic sources were searched for laboratory investigations just as they were for radiology reports. To minimize incomplete data collection, a second review of every patient who was deemed to have inappropriate staging was undertaken by one of the primary investigators. Thus, we feel that there are no “missing data”; rather, the investigations were simply not done. We also limited our cohort to patients undergoing curative surgery after 1 January 2006 because all electronic data sources were available from 2005 onwards.

Another limitation is the possibility that some of the recorded preoperative investigations were not true staging investigations but might instead have been diagnostic investigations. For example, if chest radiography was performed 1 week before the diagnosis of RCC, it was still recorded as a preoperative investigation because it was providing the appropriate information about the stage of the disease, and it would make clinical sense that the test would not be repeated. Thus, provided that the investigation was performed preoperatively, it was recorded as being performed.

The results of our study identify key areas for improving the care of RCC patients. Overutilization and underutilization of staging investigations are obvious targets, as the present work clearly illustrates. In this cohort of patients with localized RCC, underutilization of chest imaging and extended laboratory investigations was evident. A high number of chest CT exams seemed to have been performed in stage I RCC, especially by family physicians. We speculate that those exams were performed as part of a diagnostic work-up rather than as a staging investigation, given that so many were performed on the day of the kidney cancer diagnosis.

Our study also highlights another key area for quality improvement: re-evaluation of the current broad guidelines on staging localized RCC. There is a need to create more detailed risk-specific staging guidelines that not only differentiate between stage I, II, and III, but also between T1a (lesion <4 cm) and T1b (lesion 4–7 cm) tumours, whose risk of metastasis differs. For example, perhaps no chest imaging is needed for T1a tumours.

Another key area in which to improve guidelines and, hopefully, overall care is the specification for appropriate time intervals from staging investigations to curative surgery. Currently, that information does not exist in the literature for most cancers.

Our ongoing research is focusing on improving recommendations for preoperative staging investigations and, to determine if postoperative guideline recommendations are being met, on analyzing the appropriateness of postoperative imaging and laboratory investigations in this cohort of RCC patients who underwent curative surgery.

ACKNOWLEDGMENTS
This project was funded through the Dalhousie Summer Student Research Program.

CONFLICT OF INTEREST DISCLOSURES
We have read and understood Current Oncology’s policy on disclosing conflicts of interest, and we declare the following interests: LAW’s institution receives funding from Pfizer, Astrazeneca, Aragon, Exelixis, Novartis, Janssen, Roche, Bristol-Myers Squibb, and Merck for clinical trials for which she is an investigator.

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