Surgical management of stage T1 renal tumours at Canadian academic centres

Luke T. Lavallée, MD, FRCSC;[†] Simon Tanguay, MD, FRCSC;[¥] Michael A. Jewett, MD, FRCSC;[§] Lori Wood, MD, FRCPC;[±] Anil Kapoor, MD, FRCSC;[£] Ricardo A. Rendon, MD, FRCSC;[#] Ronald B. Moore, MD, FRCSC;[a] Louis Lacombe, MD, FRCSC;[b] Jun Kawakami, MD, FRCSC;[c] Stephen E. Pautler, MD, FRCSC;[d] Darrel E. Drachenberg, MD, FRCSC;[e] Peter C. Black, MD, FRCSC;[f] Jean-Baptiste Lattouf, MD, FRCSC;[g] Christopher Morash, MD, FRCSC;[*] Ilias Cagiannos, MD, FRCSC;[*] Zhihui Liu, PhD;[h] Rodney H. Breau, MSc, MD, FRCSC[*†]*

[*]Division of Urology, University of Ottawa, Ottawa, ON; [†]Clinical Epidemiology Program, Ottawa Hospital Research Institute, Ottawa, ON; [¥]Division of Urology, McGill University, Montreal, QC; [§]Division of Urology, University of Toronto, Toronto, ON; [±]Department of Medicine and Urology, Dalhousie University, Halifax, NS; [£]Division of Urology, McMaster University, Hamilton, ON; [#]Department of Urology, Dalhousie University, Halifax, NS; [a]Division of Urology, University of Alberta, Edmonton, AB; [b]Division of Urology, Université Laval, Quebec City, QC; [c]Division of Urology, University of Calgary, Calgary, AB; [d]Division of Urology, Western University, London, ON; [e]Division of Urology, University of Manitoba, Winnipeg, MB; [f]Department of Urologic Sciences, University of British Columbia, Vancouver, BC; [g]Division of Urology, Centre hospitalier de l'université de Montreal, Montreal, QC; [h]Cancer Care Ontario, Toronto, Ontario, Canada

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Abstract

Introduction: The proportion of patients with stage 1 renal tumours receiving partial nephrectomy is considered a quality of care indicator. The objective of this study was to characterize surgical practice patterns at Canadian academic institutions for the treatment of these tumours.

Methods: The Canadian Kidney Cancer Information System (CKCis) is a multicentre collaboration of 13 academic institutions in Canada. All patients with pathologic stage T1 renal tumours in CKCis were identified. Descriptive statistics were performed to characterize practice patterns over time. Associations between patient, tumour, and treatment factors with the use of partial nephrectomy were determined.

Results: From 1988 to April 2014, 1453 patients with pathologic stage 1 renal tumours were entered in the CKCis database. Of these, 977 (67%) patients had pT1a tumours; of these, 765 (78%) received partial nephrectomy. Of the total number of patients (1453), 476 (33%) had pT1b tumours; of these, 204 (43%) received partial nephrectomy. The use of partial nephrectomy increased over time from 60% to 90% for pT1a tumours and 20% to 60% for pT1b tumours. Stage pT1b (relative risk [RR] 0.56, 95% confidence interval [CI] 0.50–0.63) and minimally invasive surgical approach (RR 0.78, 95% CI 0.73–0.84 for pT1a and RR 0.23, 95% CI 0.17–0.30 for pT1b) were associated with decreased use of partial nephrectomy. Most patient factors including age, gender, body mass index, hypertension, and renal function were not significantly associated with use of partial nephrectomy ($p > 0.05$).

Conclusion: Almost all pT1a and most pT1b renal tumours managed surgically at academic centres in Canada receive partial nephrectomy. The use of partial versus radical nephrectomy appears to occur independently of patient age and comorbid status, which may indicate that urologists are performing partial nephrectomy whenever technically feasible based on tumour factors. Although the ideal proportion patients receiving partial nephrectomy cannot be determined, treatment distribution observed in this cohort may indicate an achievable case distribution among experienced surgeons.

Introduction

In 2014, an estimated 6000 Canadians will be diagnosed with kidney cancer and 1750 will die of this disease.[1] Frequent use of cross-sectional imaging increases the detection of small renal tumours and may have contributed to a stage migration observed in recent years.[2-4] It is estimated that more than 50% of newly diagnosed renal tumours are stage 1.

Surgical management options for stage 1 renal tumours include radical or partial nephrectomy, each of which may be performed via an open or minimally invasive approach.[4] Partial nephrectomy is preferred for many stage 1 tumours because it is believed to provide similar oncologic control, while preserving renal function compared to radical nephrectomy.[5-8] Impaired renal function is associated with increased risk of mortality and observational studies have shown that partial nephrectomy is associated with longer overall survival compared to radical nephrectomy.[9-11] This association was however not confirmed in a randomized trial.[12]

Currently, partial nephrectomy is recommended as the preferred treatment for stage T1a (≤4 cm) tumours and select T1b tumours (>4 to ≤7 cm) by the Canadian, American, and

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European urological Associations.[4,13,14] However, surveys done in Canada and the United States indicate considerable variation in patient management.[15,16] Furthermore, previous studies have indicated that partial nephrectomy may be underutilized.[5,17,18] Studies characterizing the management of stage 1 renal tumours in the United States indicate that although an increasing number of patients are receiving partial nephrectomy, most still receive radical nephrectomy.[17] If partial nephrectomy is also underutilized in Canada, this may be a quality of care concern.[19]

Despite the renal function benefits of partial nephrectomy, patients and surgeons may not choose it because of the unclear benefits outside of renal function preservation and the higher short-term risks of perioperative complications, such as hemorrhage and urine leak.[20,21] Furthermore whereas most surgeons are able to safely perform laparoscopic radical nephrectomy, both open and laparoscopic partial nephrectomy are technically challenging procedures. In this context, underutilization of partial nephrectomy may also be based on surgeon comfort with a particular surgical approach rather than tumour or patient characteristics.

Characterizing practice patterns in Canada is important as a national measure of kidney cancer care. Use of partial nephrectomy for stage 1 renal tumours was identified as a quality of care indicator by Canadian kidney cancer experts.[19] Although the ideal proportion of stage 1 renal tumours that should receive partial nephrectomy is unknown, we hypothesized that (1) partial nephrectomy is underutilized in Canada; (2) older patients and those with medical comorbidities are less likely to receive partial nephrectomy; and (3) patients with renal dysfunction are more likely to receive partial nephrectomy. We assessed the proportion of patients with stage 1 renal tumours who receive partial nephrectomy and determined patient, tumour, and surgical factors associated with treatment choice.

Methods

A historical cohort of patients was identified from the Canadian Kidney Cancer information system (CKCis). The Ottawa Hospital Research Ethics Board approved this study (protocol number 20130139–01H) and all centres obtained review board approval to contribute to CKCis. CKCis is a multicentre collaboration of 13 academic hospitals in 6 Canadian provinces. It was initiated in 2011 and includes data entered retrospectively and prospectively for a sample of patients with renal tumours treated as of 1988. All data prior to 2011 were entered retrospectively. Data after 2011 may have been entered prospectively or retrospectively. To be included in CKCis, patients may have any tumour stage, may receive any form of treatment, and must provide consent. Patient, tumour, and treatment information are based on medical record review.

Patients who received surgery and were found to have stage 1 renal tumours (organ-confined, size ≤7 cm) were eligible for inclusion in this study. Patient characteristics collected from CKCis included age, gender, body mass index (BMI), preoperative renal function (estimated glomerular filtration rate [eGFR]), hypertension, smoking history, diabetes, cardiovascular disease, and family history of renal tumours. Tumour characteristics included tumour stage, tumour size, and number of renal tumours. Treatment characteristics included year of surgery, type of surgery (partial vs. radical nephrectomy), and surgical approach (open vs. minimally invasive laparoscopic/robotic).

Patients were stratified by tumour stage (pT1a or pT1b) for analyses. Descriptive statistics were performed to summarize the data. For each year during the study period, the proportion of patients who received open or minimally invasive partial or radical nephrectomy was identified. Univariable associations between patient, tumour, treatment factors, and use of partial nephrectomy (primary outcome) were assessed using log-binomial regression and presented as relative risks (RR) with 95% confidence intervals (CI). Multivariable log-binomial regression was performed by including factors significantly associated with partial nephrectomy in univariable analyses and variables considered to be clinically important by investigators. All analyses were performed using the R statistical environment.

Results

Study cohort characteristics

At the time of analyses, 3511 patients had data entered in CKCis. Of these, 1453 had pathologically confirmed stage 1 renal tumours (pT1) (Table 1). Overall, the median age at kidney cancer diagnosis was 59 and most patients were male (902; 62%). In total, 977 (67%) had a pT1a tumour and 476 (33%) had a pT1b tumour. Of the patients whose renal function was recorded (n = 1071), 173 (16%) had renal impairment defined as an eGFR <60 mL/min/1.73m^2.

Association between tumour stage and treatment

The association between tumour stage and partial nephrectomy was evaluated using univariable and multivariable log-binomial regression. After adjusting for surgical approach and patient factors, patients with pT1b tumours were 44% less likely to receive partial nephrectomy compared to patients with pT1a tumours (RR 0.56, 95% CI 0.50–0.63).

Surgical treatment of pT1a tumours

Among pT1a patients, 765 (78%) received partial nephrectomy overall, and the use of partial nephrectomy has increased

Table 1. Patient, tumour, and treatment characteristics of 1453 pathological T1 renal tumours receiving surgery in the CKCis database

Characteristics	Stage pT1a (n = 977)		Stage pT1b (n = 476)	
	Partial nephrectomy, n (%)	Radical nephrectomy, n (%)	Partial nephrectomy, n (%)	Radical nephrectomy, n (%)
Total no. patients	765	212	204	272
Patient characteristics				
Age at diagnosis, years (median [range])	58.8 (20.3–85.4)	60.7 (18.8–87.2)	61.4 (21.5–85.1)	59.6 (29.0–81.8)
Male	468 (61)	125 (59)	137 (67)	172 (63)
BMI				
<20	5 (2)	-	3 (4)	4 (5)
20-24.9	47 (19)	12 (20)	10 (12)	17 (22)
25-29.9	89 (36)	21 (36)	30 (37)	22 (29)
30-34.9	72 (29)	14 (24)	22 (27)	18 (23)
≥35	36 (14)	12 (20)	16 (20)	16 (21)
Unknown	516 (68)	153 (72)	123 (60)	195 (72)
Preoperative renal function (eGFR, mL/min/1.73m^2)				
>90	242 (32)	56 (26)	62 (30)	54 (20)
60–89.9	275 (36)	60 (28)	62 (30)	87 (32)
30–59.9	60 (8)	21 (10)	29 (14)	25 (9)
<30	3 (0.4)	8 (4)	1 (0.5)	8 (3)
ESRD	4 (0.5)	9 (4)	0 (0)	5 (2)
Unknown	181 (24)	58 (27)	50 (25)	93 (34)
Family history of renal tumour	52 (7)	22 (10)	5 (2)	23 (8)
Diabetes	114 (15)	36 (10)	47 (23)	43 (16)
Hypertension	309 (40)	101 (48)	98 (48)	128 (47)
Cardiovascular disease	54 (7)	22 (10)	14 (7)	22 (8)
Smoking status				
Currently smoking	87 (17)	24 (18)	30 (22)	34 (19)
Previous smoker	210 (41)	60 (45)	50 (37)	74 (41)
Never smoked	210 (41)	45 (34)	53 (40)	72 (40)
Unknown	9 (2)	3 (2)	1 (1)	-
Tumour characteristics				
No. renal tumours				
1	700 (95)	185 (92)	183 (94)	240 (94)
2	21 (3)	11 (6)	8 (4)	11 (4)
3	8 (1)	1 (<1)	2 (1)	-
4	2 (<1)	2 (1)	1 (1)	1 (<1)
≥5	3 (<1)	1 (<1)	1 (1)	2 (1)
Pathological tumour size, cm				
0–1.9	241 (33)	29 (15)	-	-
2–2.9	291 (40)	61 (31)	-	-
3–3.9	197 (27)	106 (54)	-	-
4–4.9	-	-	119 (64)	111 (43)
5–5.9	-	-	39 (21)	89 (35)
6–6.9	-	-	29 (15)	55 (22)
Unknown	36 (5)	16 (8)	17 (8)	17 (6)

CKCis: Canadian Kidney Cancer information system; BMI: body mass index; eGFR: estimated glomerular filtration rate; ESRD: end-stage renal disease.

over time for these patients (Fig. 1a). A minimally invasive approach was more commonly used for radical nephrectomy (156; 73%) compared to partial nephrectomy (n = 362; 47%). However, minimally invasive partial nephrectomy was the most common surgical treatment modality for pT1a tumours treated in 2014 (Fig. 1b).

In univariable analysis, BMI <20 kg/m^2 (RR 1.26, 95% CI 1.10–1.43) and later year of surgery were associated with increased use of partial nephrectomy for pT1a tumours, while severely impaired renal function (eGFR <30 RR 0.34, 95% CI 0.13–0.88), minimally invasive approach (RR 0.78, 95% CI 0.73–0.84), and larger tumour size were associated

Table 1 (cont'd). Patient, tumour, and treatment characteristics of 1453 pathological T1 renal tumours receiving surgery in the CKCis database

Characteristics	Stage pT1a (n = 977)		Stage pT1b (n = 476)	
	Partial nephrectomy, n (%)	Radical nephrectomy, n (%)	Partial nephrectomy, n (%)	Radical nephrectomy, n (%)
Treatment characteristics				
Year of surgery				
1990–2005	27 (4)	21 (10)	5 (2)	24 (9)
2005–06	17 (2)	9 (4)	1 (<1)	6 (2)
2006–07	22 (3)	7 (3)	5 (2)	8 (3)
2007–08	39 (5)	26 (12)	9 (4)	17 (6)
2008–09	60 (8)	20 (9)	7 (3)	25 (9)
2009–10	63 (8)	22 (10)	13 (6)	33 (12)
2010–11	88 (12)	23 (11)	24 (12)	26 (10)
2011–12	139 (18)	29 (14)	42 (21)	46 (17)
2012–13	176 (23)	35 (17)	53 (26)	54 (20)
2013–14	129 (17)	18 (8)	44 (22)	31 (11)
Unknown	5 (1)	2 (1)	1 (<1)	2 (1)
Surgical approach				
Open	399 (52)	48 (23)	159 (78)	54 (20)
Laparoscopic	313 (41)	155 (73)	39 (19)	211 (78)
Robotic	49 (6)	1 (<1)	4 (2)	1 (<1)
Unknown	4 (1)	8 (4)	2 (1)	6 (2)

CKCis: Canadian Kidney Cancer information system; BMI: body mass index; eGFR: estimated glomerular filtration rate; ESRD: end-stage renal disease.

with decreased use of partial nephrectomy (Table 2, Table 3). In the multivariable model, use of a minimally invasive approach (RR 0.80, 95% CI 0.74–0.86) and receiving surgery before 2010 remained associated with decreased use of partial nephrectomy. None of the patient characteristics were significantly associated with use of partial nephrectomy in the multivariable model.

Surgical treatment of pT1b tumours

Overall, 204 patients with pT1b tumours (43%) were treated with partial nephrectomy during the study period. The use of a minimally invasive approach was higher among radical nephrectomy patients (212; 78%) compared to partial nephrectomy patients (43; 21%). Among patients with pT1b tumours, there was an increase in open and minimally invasive partial nephrectomy over time and in the 2013–2014 years more pT1b tumours received partial than radical nephrectomy (Fig. 2a, Fig. 2b).

In univariable analyses, diabetes (RR 1.28, 95% CI 1.02–1.62) and later year of surgery were associated with increased use of partial nephrectomy for pT1b tumours; whereas family

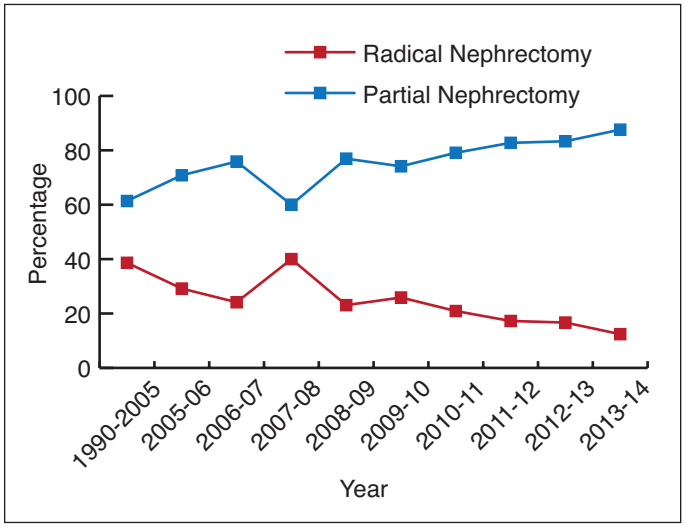

Fig. 1a. Percentage of patients receiving partial versus radical nephrectomy for pT1a tumours between 1990 and 2014.

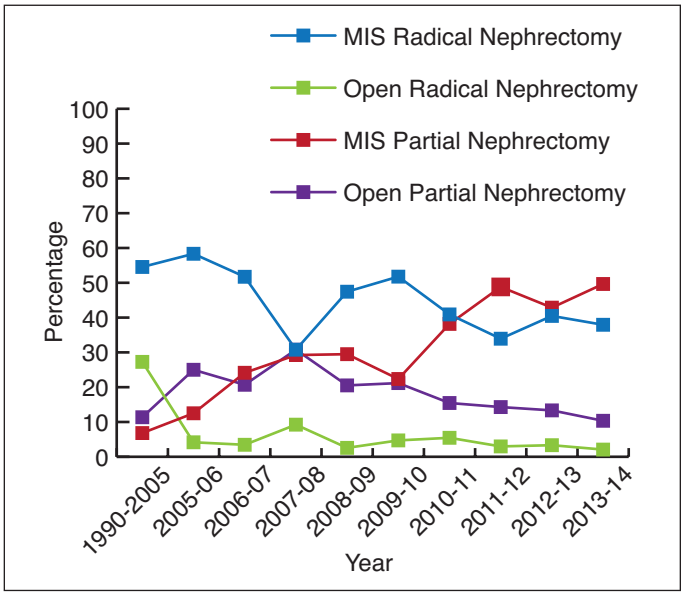

Fig. 1b. Percentage of patients receiving open versus minimally invasive (MIS) partial or radical nephrectomy for pT1a tumours between 1990 and 2014.

Table 2. Univariable and multivariable log-binomial regression of patient and surgical characteristics associated with partial nephrectomy in pT1 renal tumours

Variable	pT1a		pT1b	
	Univariable RR (95% CI)	Multivariable RR (95% CI)	Univariable RR (95% CI)	Multivariable RR (95% CI)
Age at diagnosis, years				
<50	1.0	1.0	1.0	1.0
50–59	1.03 (0.94–1.13)	0.99 (0.89–1.10)	1.05 (0.77–1.44)	1.25 (0.93–1.67)
60–69	1.00 (0.91–1.09)	0.96 (0.85–1.08)	1.17 (0.87–1.58)	1.11 (0.78–1.57)
70–79	0.93 (0.82–1.04)	0.91 (0.77–1.07)	0.97 (0.67–1.41)	0.91 (0.56–1.49)
≥80	0.79 (0.54–1.17)	0.53 (0.27–1.04)	1.41 (0.71–2.81)	1.51 (0.83–2.77)
Sex				
Male	1.0	1.0	1.0	1.0
Female	0.98 (0.92–1.05)	1.06 (0.97¬1.14)	0.91 (0.72–1.13)	0.92 (0.72–1.18)
Family history of renal tumour	0.89 (0.76–1.04)	-	0.40 (0.18–0.90)	-
Smoking status				
Current smoker	1.0	1.0	1.0	1.0
Previous smoker	0.99 (0.88–1.12)	1.03 (0.92–1.16)	0.86 (0.61–1.21)	0.85 (0.65–1.11)
Never smoked	1.05 (0.94–1.18)	1.09 (0.97–1.22)	0.91 (0.65–1.26)	0.82 (0.60–1.11)
BMI				
<20	1.26 (1.10–1.43)	-	1.16 (0.03–1.33)	-
20–24.9	1.0	-	1.0	-
25–29.9	1.02 (0.87–1.19)	-	1.56 (0.90–2.68)	-
30–34.9	1.05 (0.90–1.23)	-	1.49 (0.84–2.62)	-
≥35	0.94 (0.76–1.16)	-	1.35 (0.74–2.46)	-
Preoperative renal function (eGFR)				
>90	1.0	1.0	1.0	1.0
60–89.9	1.01 (0.94–1.09)	0.98 (0.90–1.08)	0.78 (0.60–1.01)	0.94 (0.71–1.26)
30–59.9	0.91 (0.79–1.05)	0.97 (0.84–1.11)	1.01 (0.74–1.36)	1.18 (0.84–1.65)
<30	0.34 (0.13–0.88)	0.33 (0.10–1.11)	0.21 (0.03–1.33)	N/A
ESRD	0.38 (0.17–0.86)	0.40 (0.16–1.02)	N/A	N/A
Diabetes	0.97 (0.88–1.06)	0.95 (0.84–1.08)	1.28 (1.02–1.62)	0.98 (0.77–1.26)
Hypertension	0.94 (0.87–1.00)	1.00 (0.92–1.09)	1.02 (0.83–1.26)	1.10 (0.87–1.39)
Cardiovascular disease	0.90 (0.78–1.04)	1.02 (0.88–1.18)	0.90 (0.59–1.38)	1.20 (0.80–1.79)
MIS approach[a]	0.78 (0.73–0.84)	0.80 (0.74–0.86)	0.23 (0.17–0.30)	0.22 (0.15–0.33)
Year of surgery				
1990–2005	0.64 (0.50–0.83)	0.86 (0.65–1.16)	0.29 (0.13–0.67)	0.62 (0.28–1.40)
2005–06	0.75 (0.56–0.99)	0.75 (0.54–1.04)	0.24 (0.04–1.51)	0.56 (0.22–1.45)
2006–07	0.86 (0.70–1.07)	0.66 (0.43–1.00)	0.66 (0.32–1.34)	N/A
2007–08	0.68 (0.56–0.84)	0.88 (0.73–1.06)	0.59 (0.34–1.04)	0.88 (0.42–1.28)
2008–09	0.85 (0.74–0.98)	0.82 (0.69–0.99)	0.37 (0.19–0.74)	0.81 (0.46–1.42)
2009–10	0.84 (0.73–0.97)	0.77 (0.65–0.93)	0.48 (0.29–0.79)	0.73 (0.42–1.28)
2010–11	0.90 (0.81–1.01)	0.94 (0.82–1.07)	0.82 (0.58–1.16)	0.61 (0.35–1.04)
2011–12	0.94 (0.86–1.03)	0.97 (0.88–1.08)	0.81 (0.61–1.09)	0.81 (0.62–1.06)
2012–13	0.95 (0.87–1.04)	0.92 (0.83–1.02)	0.84 (0.65–1.11)	0.88 (0.65–1.19)
2013–14	1.0	1.0	1.0	1.0

CI: confidence interval; BMI: body mass index; MIS: minimally invasive surgical; eGFR: estimated glomerular filtration rate; ESRD: end-stage renal disease. [a]Minimally invasive surgical approach includes laparoscopic or robotic procedures. N/A indicates relative risk could not be calculated.

history of renal tumours (RR 0.40, 95% CI 0.18–0.90) and minimally invasive approach (RR 0.23, 95% CI 0.17–0.30) were associated with decreased use of partial nephrectomy (Table 2). In the multivariable model, only the use of a minimally invasive approach (laparoscopic or robotic) was associated with partial nephrectomy (RR 0.22, 95% CI 0.15–0.33). Other patient factors, including age, gender, BMI, smoking status, hypertension, and cardiovascular disease, were not statistically significantly associated with use of partial nephrectomy in multivariable analysis.

Table 3. Univariable log-binomial regression of tumour size and use of partial nephrectomy for pT1 renal tumours

Variable	pT1 renal tumours RR (95% CI)
Tumour size, cm	
0–1	1.0
2–2.9	0.93 (0.87–0.99)
3–3.9	0.73 (0.66–0.80)
4–4.9	0.58 (0.51–0.66)
5–5.9	0.35 (0.27–0.45)
6–6.9	0.38 (0.28–0.51)

CI: confidence interval.

Discussion

Surgical removal is the primary curative treatment for patients with renal tumours. Clinical guidelines recommend partial nephrectomy for most stage T1a and some T1b renal tumours, given the improved renal preservation and similar oncologic outcomes associated with this procedure compared to radical nephrectomy. In this study, we described the surgical treatment approach used for patients with stage 1 renal tumours at 13 Canadian academic centres. We observed that most pT1a renal masses were treated with partial nephrectomy. Also, there has been a notable increase in the use of a minimally invasive approach for pT1a tumours. Among pT1b tumours, open partial nephrectomy and minimally invasive radical nephrectomy were the most common treatments.

Prior to this study, we hypothesized that partial nephrectomy may be underutilized in Canadian patients, particularly in older patients with comorbidities. However, this does not seem to be true, at least for the academic centres participating in CKCis. Our findings were comparable to those reported by Memorial Sloan Kettering Cancer Center, where about 80% of T1a tumours and 60% of T1b tumours were treated with partial nephrectomy.[22] Similar data have been reported for high volume centres within the United States National Cancer Database, where 50% of stage 1 tumours were treated with partial nephrectomy.[17] It is unknown if a similar proportion of Canadian patients receive partial nephrectomy when treated outside of an academic centre, since receiving surgery in academic centres has been associated with increased use of partial nephrectomy.[23] Given the differences between partial nephrectomy use in academic and non-academic centres in the United States, a population-based assessment is warranted.[18]

In our cohort, the increase in partial nephrectomy for pT1a tumours appears to be predominantly driven by more frequent use of minimally invasive partial nephrectomy. For pT1b tumours, an increase in open partial nephrectomy was observed over the study period. For both pT1a and pT1b tumours, there has been a corresponding decrease in the use of minimally invasive radical nephrectomy. Possible explanations for the observed treatment trends are that surgeons are becoming more experienced with laparoscopic surgery, oncologic outcomes of partial nephrectomy are equivalent to radical nephrectomy, or there is a greater awareness of the negative consequences of impaired renal function with radical nephrectomy.[5,24,25] Interestingly, our findings are not consistent with a population-based study from Ontario that evaluated patients from 1995 to 2004.[26] In the Ontario cohort, the adoption of laparoscopic surgery was associated

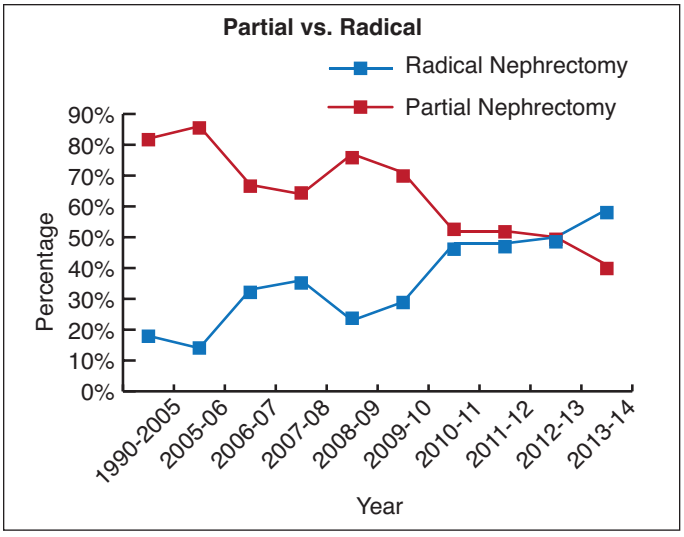

Fig. 2a. Percentage of patients receiving partial versus radical nephrectomy for pT1b tumours between 1990 and 2014.

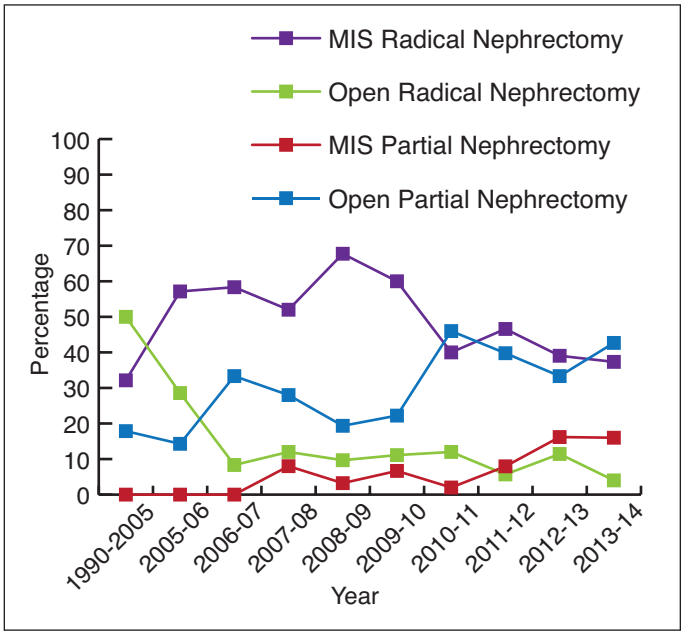

Fig. 2b. Percentage of patients receiving open versus minimally invasive (MIS) partial or radical nephrectomy for pT1b tumours between 1990 and 2014.

with an increased use of radical nephrectomy. A more contemporary evaluation of population treatment trends would help determine whether this trend has reversed. It is possible that our study slightly overestimated partial nephrectomy use because some academic centres will occasionally refer stage 1 tumours requiring radical nephrectomy to non-academic hospitals for management; however this would likely occur in a minority of patients.

Our findings were consistent with previous studies that examined non-patient factors associated with use of partial nephrectomy. For example, lower tumour stage, open surgical approach, and more recent year of surgery have all been associated with increased use of partial nephrectomy.[22,27] However, a novel finding from this study is that most patient factors (age, gender, smoking status, BMI, renal function, hypertension, cardiovascular disease) were not significantly associated with use of partial nephrectomy. This finding contradicts most previous studies. For example, respondents to recent physician surveys from Canada and the United States indicate that age and comorbid status influence their choice of surgery.[15,16] Also, previous population-based and large single centre studies reported that factors, such as younger age, male gender, and lower Charlson comorbidity score, were associated with increased use of partial nephrectomy.[22,27] We believe these data indicate that Canadian urologists working at academic centres are performing partial nephrectomies when technically feasible irrespective of most patient factors. Urologists likely base their surgical approach on tumour factors, such as tumour size and location, that are known to increase the risk of perioperative complications.[28-30] Indeed, perhaps the most striking finding is the fact that patients with historical indications for partial nephrectomy, such as impaired renal function (eGFR <60 mL/min/1.73m^2), were not more likely to receive partial nephrectomy than patients with normal renal function. Patients with tumours amenable to partial nephrectomy appear to be receiving this procedure regardless of renal function.

One of the major strengths of this study is that the data comes from 13 centres across Canada, making the results more generalizable than previously published single-centre or single-province studies. Also, compared to physician surveys, this study measures the actual management of patients, rather than assessing physician preferences. Furthermore, we were able to observe trends over a long period allowing a broader review of treatment practices. Lastly, compared to population-based studies, considerable patient and treatment details are available from the CKCis database.

Several limitations of this study must also be considered when interpreting the results. A portion of the cohort was collected retrospectively. Our cohort only included patients managed at academic hospitals by physicians who enrolled patients in CKCis. Thus, patient selection may be biased and the results may not represent management of stage 1 renal tumours in the Canadian population as a whole. Also, because pathologic stage was used instead of clinical stage, a proportion of clinical T1 tumours may have been classified as pT3 and excluded from our cohort. If these tumours were managed differently from tumours that were not upstaged, this may have slightly skewed the observed trends. Finally, although considerable detail was available in CKCis for analysis, some tumour factors, such as location, depth into the kidney (endophytic extent), and association with the collecting system, were not available.

Conclusion

Almost all pT1a and most pT1b renal tumours managed surgically at academic centres in Canada receive partial nephrectomy. The use of partial versus radical nephrectomy appears to occur independently of patient age and comorbid status, which may indicate that urologists are performing partial nephrectomy whenever technically feasible based on tumour factors, such as size and location in the kidney. Although the ideal proportion of patients receiving partial nephrectomy cannot be determined, since treatment choice depends on multiple factors including patient preference and surgeon comfort with each approach, treatment distribution observed in this cohort may serve as a reference indicating achievable case distribution among experienced surgeons.

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Correspondence: Dr. Rodney H. Breau, Associate Scientist, Ottawa Hospital Research Institute, Division of Urology, Department of Surgery, University of Ottawa, 501 Smyth Rd, Box 222 Ottawa, ON K1H 8L6; rbreau@toh.on.ca