Trends in the Use of Gross and Frozen Section Pathological Consultations During Partial or Radical Nephrectomy for Renal Cell Carcinoma

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Purpose: There is no consensus regarding the role of intraoperative pathological consultation during kidney cancer surgery. Accordingly intraoperative pathological consultation use is susceptible to variation based on nonclinical factors. We explored this hypothesis by evaluating national trends in the use of intraoperative pathological consultation during radical or partial nephrectomy with time, across regions, and by patient and provider characteristics.

Materials and Methods: Using linked Surveillance, Epidemiology and End Results-Medicare data we identified a cohort of patients who underwent partial or radical nephrectomy from 1991 to 2002. In each case we ascertained corresponding Medicare claims for gross and/or frozen section intraoperative pathological consultation. We assessed variations in the use of intraoperative pathological consultation by year of treatment and geographic region as well as by patient and provider characteristics.

Results: We identified 7,507 cases treated with partial (600 or 8.0%) or radical (6,907 or 92.0%) nephrectomy from 1991 through 2002. Of cases treated with radical nephrectomy 744 (10.8%) and 843 (12.2%) received gross and frozen section intraoperative pathological consultation, respectively. Of cases treated with partial nephrectomy 67 (11.2%) had an intraoperative gross consultation and 323 (53.8%) had a frozen section evaluation. Use of intraoperative pathological consultation (gross or frozen section) during partial and radical nephrectomy varied based on patient demographics, United States Census region, and Surveillance, Epidemiology and End Results registry ($p < 0.05$). Intraoperative pathological consultation during radical nephrectomy differed by year of treatment ($p < 0.05$). Intraoperative pathological consultation use also varied based on provider characteristics ($p < 0.05$).

Conclusions: Intraoperative pathological consultation use during kidney cancer surgery varies with time, across geographic regions and based on patient demographics and broadly defined provider characteristics. These data provide context for future studies seeking to refine the use of intraoperative pathological consultation in this clinical setting.

Key Words: kidney; kidney neoplasms; pathology, surgical; frozen sections; trends

The optimal use of IPC during kidney cancer surgery is neither well-defined nor supported by a robust evidence base.[1–3] In a recent review of this topic indications for IPC during kidney surgery included frozen section consultations to facilitate diagnostic confirmation, evaluate margin and lymph node status, and/or assess the nature of incidentally detected pathology.[1] However, in the same study IPC was also frequently requested for less intuitive reasons, including the gross identification of parenchymal or pelvic masses in already excised radical nephrectomy specimens.[1] In addition to having poorly defined indications, IPC seldom influences clinical decision making during kidney cancer surgery[4,5] and there is no convincing evidence that such consultations impact long-term treatment outcomes.

Given the uncertainty surrounding clinical indications and potential benefits to patients, we hypothesized that the use of gross and frozen section consultations during kidney cancer surgery would vary based on nonclinical factors. Specifically we posited that higher surgeon volume would be associated with less frequent use of gross and frozen section IPC due to (among other factors) greater confidence regarding margin status among more experienced surgeons. Also, given the lack of agreement on the optimal use of frozen sections during partial or radical nephrectomy, we hypothesized that use of frozen section IPC would demonstrate temporal and geographic variation.[6,7] We tested these hypotheses using linked SEER-Medicare data to evaluate national trends in IPC use during radical or partial nephrectomy with time, across regions, and by various patient and provider characteristics. By describing and clarifying current national practice patterns we believe these data may

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inform efforts to refine the use of IPC during kidney cancer surgery, thereby improving the quality and efficiency of care in patients with kidney cancer.

MATERIALS AND METHODS

Data Source

We used linked data from the National Cancer Institute SEER program and CMS to identify and characterize a cohort of older patients with incident kidney cancer diagnosed from 1991 through 2002. Medicare claims for this cohort are available through December 31, 2003.

SEER is a population based cancer registry that collects data on incidence, treatment and mortality. The demographic composition, cancer incidence and mortality trends in the SEER registries are representative of the entire United States population.[8]

From 1991 through 1999, 11 SEER affiliated registries, including San Francisco, San Jose (1992), Los Angeles (1992), Connecticut, Detroit, Hawaii, Iowa, New Mexico, Seattle, Utah and Atlanta, provided incident cases for linkage with health care claims covered by CMS. In 2000 the SEER-Medicare data set expanded to include cases from the Greater California, Louisiana, New Jersey and Kentucky tumor registries. The Medicare program provides primary health insurance for 97% of the United States population 65 years or older. Successful linkage with CMS claims is achieved for more than 90% of Medicare patients whose cancer specific data are tracked by SEER.[9]

Cohort Identification

We used American Medical Association CPT codes to identify patients with a Medicare claim for radical nephrectomy (CPT codes 50220, 50225, 50230, 50545 and 50546) or partial nephrectomy (CPT codes 50240, 50542 and 50543) between 1991 and 2003. For each patient undergoing partial or radical nephrectomy we then searched for physician claims for gross section (CPT code 88329) and/or frozen section (CPT codes 88331 and 88332) IPC submitted within 30 days of hospitalization for the index cancer surgery. We used ICD-Oncology 3 and specific histology codes to distinguish patients with renal cortical neoplasms from those with upper urinary tract urothelial carcinoma. The latter patients were excluded from analysis.

Patient Characteristics

We used SEER variables to ascertain demographic and cancer specific information, ie age at surgery, sex, race/ethnicity, marital status, United States Census region, SEER registry and year of surgery, for each case in the analytical cohort. We assigned 2002 as the year of treatment for the small number of patients who were diagnosed in 2002 but in whom surgery was not performed until 2003. We collapsed tumor size into 2 clinically relevant categories based on a 4 cm threshold.[10] We assigned median census tract income and the census tract percent of nonhigh school graduates as patient level measures of income and education, respectively.[11]

We measured preexisting comorbidity using a modification of the Charlson Index by identifying comorbid conditions, including diabetes, renal insufficiency and cardiovascular disease, from inpatient and physician claims submitted during the 12-month period before the index hospital admission for kidney cancer surgery.[12]

Provider Characteristics

We used encrypted Unique Physician Identifier Numbers submitted with Medicare physician claims to identify a primary surgeon for each patient in the analytic cohort. We used data from the American Medical Association Physician Masterfile to more fully describe surgeon demographic characteristics.[13]

Using claims from 1991 to 2002 we determined the average annual nephrectomy volume for each surgeon. For radical nephrectomy we empirically defined high volume providers as surgeons whose average annual SEER-Medicare case volume was 6 or higher, representing the top quartile of average annual case volume for radical nephrectomy. For partial nephrectomy we defined high volume providers as those performing an average of at least 2 partial nephrectomies annually, again representing the top quartile of surgeons for partial nephrectomy volume. Notably this measure of case volume may not reflect the total number of nephrectomies performed by a provider. It fails to account for surgery in younger (nonMedicare eligible) patients, Medicare health maintenance organization enrollees and/or fee for service Medicare participants who reside outside of the SEER registries.

Statistical Analysis

On bivariate analysis we used the chi-square test to evaluate the level of association between the use of IPC (gross or frozen section) during radical or partial nephrectomy and patient demographics, geographic region and year of treatment. We performed identical analyses for radical and partial nephrectomy.

We defined 2 primary outcomes for our multivariate analyses, including the receipt of 1) gross IPC during radical nephrectomy and 2) frozen section IPC during partial nephrectomy. We chose these 2 outcomes because in our view the indications for IPC are poorly defined for the former and reasonably well-defined for the latter. For each outcome we then fit multivariate logistic regression models to evaluate the independent association of year of treatment, geographic region and/or patient demographics with our primary outcomes. For each model we included certain independent variables, including year of treatment, United States census region, age at diagnosis, sex, race/ethnicity, marital status, census tract education quartile, census tract income quartile, Charlson Index score and tumor size. All statistical testing was 2-sided and done at the 5% significance level using SAS®, version 9.1. The institutional review board at University of California-Los Angeles approved this study.

RESULTS

We identified 7,507 cases treated with partial (600 or 8.0%) or radical (6,907 or 92.0%) nephrectomy from 1991 through 2002. Of patients undergoing radical nephrectomy 744 (10.8%) and 843 (12.2%) received gross and frozen section IPC, respectively. Of patients undergoing partial nephrectomy 67 (11.2%) had an intraoperative gross consultation and 323 (53.8%) had an intraoperative frozen section.

Tables 1 (radical nephrectomy) and 2 (partial nephrectomy) show the use of gross and frozen section IPC stratified by patient characteristics, year of treatment and geographic region. For patients undergoing radical nephrectomy we observed variation in the receipt of IPC (gross or frozen section) based on multiple patient demographic factors, year of treatment, United States census region and SEER registry ($p < 0.05$, table 1). The use of IPC during partial nephrectomy differed across age, marital status, United States Census region and SEER registry strata ($p < 0.05$) but not by year of treatment (table 2). Of patients who underwent partial nephrectomy frozen section consultation was more frequent in those with tumors 4 cm or less (56.3% vs 46.6%, $p < 0.05$, table 2).

We identified 1,904 primary surgeons who performed a total of 7,170 partial or radical nephrectomies, representing 96% of all cases in the analytical cohort, during the study interval. Of cases with identifiable primary surgeons 1,849 surgeons performed a total of 6,589 radical nephrectomies and 55 performed a total of 581 partial nephrectomies. IPC use varied based on provider characteristics (tables 3 and 4). More recent medical school graduates requested fewer gross consultations during radical nephrectomy ($p < 0.05$, table 3). Frozen sections during radical nephrectomy were less commonly used by in solo or 2-physician practices ($p < 0.05$, table 3). More recent medical school graduates were in general more likely to use frozen sections during partial nephrectomy ($p < 0.05$, table 4). IPC use did not vary based on our provider case volume thresholds (tables 3 and 4).

Table 5 lists the results of our multivariate analyses. Several patient demographic variables were independently associated with gross IPC during radical nephrectomy. However, the strongest association was with United States Census region. Cases from the Midwest (OR 0.57, 95% CI 0.47–0.69), Northeast (OR 0.26, 95% CI 0.20–0.35) and South (OR 0.19, 95% CI 0.12–0.28) census regions were significantly less likely than those from the West to receive a gross consultation during radical nephrectomy (table 5). Geographic (census) region was the only independent determinant of frozen section IPC during partial nephrectomy with patients from the West census region least likely to receive this service (table 5).

TABLE 1. *Characteristics of 6,907 patients by receipt of intraoperative pathological gross or microscopic consultation at radical nephrectomy*

	No. Gross IPC (%)	No. Frozen Section IPC (%)
Age at diagnosis:*		
60–69	169 (10.7)	210 (13.3)
70–79	426 (10.6)	507 (12.6)
80 or Older	149 (11.4)	126 (9.6)
Sex:*		
M	426 (10.6)	522 (13.0)
F	318 (11.0)	321 (11.1)
Race/ethnicity:*		
Black	41 (8.4)	41 (8.4)
Hispanic	35 (9.3)	35 (9.3)
Other	19 (8.1)	35 (14.9)
White	649 (11.2)	732 (12.6)
Marital status:†		
Single	41 (9.4)	51 (11.7)
Married	499 (11.8)	554 (13.0)
Separated	1 (5.9)	2 (11.8)
Divorced	39 (12.0)	29 (8.9)
Widowed	143 (8.7)	187 (11.4)
Unknown	21 (8.8)	20 (8.3)
Education quartile:*,†		
Lowest	477 (11.8)	537 (13.3)
3rd	113 (10.5)	117 (10.9)
2nd	84 (9.0)	110 (11.8)
Top	70 (8.0)	79 (9.1)
Median income quartile:*,†		
Lowest	146 (8.7)	190 (11.4)
3rd	167 (9.4)	245 (13.7)
2nd	203 (11.3)	193 (10.8)
Top	228 (13.8)	215 (13.0)
Charlson Index score:		
0	598 (10.7)	703 (12.6)
1–2	117 (11.0)	115 (10.8)
3 or Greater	29 (11.4)	25 (9.8)
Tumor size (cm):*		
4 or Less	274 (10.8)	335 (13.2)
Greater than 4	453 (10.9)	479 (11.6)
Treatment yr:†		
1991‡	42 (10.4)	60 (14.9)
1992	63 (13.9)	61 (13.4)
1993	69 (14.1)	65 (13.3)
1994	34 (7.0)	73 (15.1)
1995	65 (12.4)	72 (13.7)
1996	63 (13.2)	61 (12.8)
1997	54 (12.8)	51 (12.1)
1998	53 (11.6)	45 (9.9)
1999	70 (14.3)	61 (12.4)
2000	95 (9.4)	95 (9.4)
2001	85 (7.8)	131 (12.0)
2002§	51 (8.5)	68 (11.3)
United States Census region:†		
Midwest	200 (10.3)	246 (12.7)
Northeast	79 (5.7)	145 (10.5)
South	27 (3.3)	91 (11.3)
West	438 (15.7)	361 (13.0)
SEER registry:*,†		
Connecticut	68 (7.7)	105 (12.0)
Detroit	96 (8.8)	84 (7.7)
Hawaii	7 (6.5)	16 (15.0)
Iowa	104 (12.3)	162 (19.1)
New Mexico	9 (3.6)	28 (11.1)
Seattle	51 (9.4)	69 (12.7)
Utah	7 (3.7)	24 (12.8)
Atlanta	10 (3.4)	29 (9.9)
Rural Georgia	Less than 5 (0)	Less than 5 (5.6)
Kentucky	12 (4.5)	35 (13.2)
Louisiana	5 (2.2)	26 (11.2)
New Jersey	11 (2.2)	40 (8.0)
California	364 (21.5)	224 (13.2)

* Frozen section IPC $p < 0.05$.
† Gross IPC $p < 0.05$.
‡ Includes a small number of patients from 1990.
§ Includes a small number of patients from 2003.

DISCUSSION

As a step toward better defining optimal clinical application, we describe national trends in the use of gross and/or frozen section IPC in patients undergoing radical or partial nephrectomy for kidney cancer. We report 2 principal findings. 1) In elderly Medicare beneficiaries IPC is obtained during approximately 10% of radical nephrectomies and 50% of partial nephrectomies. 2) The frequency of IPC during kidney cancer surgery varies with time, across geographic regions, and based on patient demographic factors and broadly defined provider characteristics.

The observed geographic variation by United States Census region and SEER registry in this study reflects (at least partially) a lack of professional consensus regarding the indications for and benefits derived from IPC during kidney cancer surgery. To clarify, in the setting of uncertain benefits surgeons and pathologists may have idiosyncratic preferences or traditions with respect to IPC use during partial or radical nephrectomy.[6,7,14,15] Such practice styles are often

TABLE 2. *Characteristics of 600 by receipt of intraoperative pathological gross or microscopic consultation at partial nephrectomy*

	No. Gross IPC (%)	No. Frozen section IPC (%)
Age at diagnosis‡:*		
60–69	21 (14.9)	81 (57.4)
70–79	32 (8.6)	205 (54.8)
80 or Older	14 (16.5)	37 (43.5)
Sex:		
M	50 (13.0)	203 (52.7)
F	17 (7.9)	120 (55.8)
Race/ethnicity:		
Black	5 (12.8)	15 (38.5)
Hispanic	Less than 5 —	19 (54.3)
Other	Less than 5 —	15 (75.0)
White	56 (11.1)	274 (54.2)
Marital status‡:*		
Single	5 (12.5)	14 (35.0)
Married	48 (12.3)	211 (54.1)
Separated	0	0
Divorced	Less than 5 —	19 (73.1)
Widowed	12 (10.2)	66 (55.9)
Unknown	Less than 5 —	13 (50.0)
Education quartile:		
Lowest	30 (10.3)	156 (53.8)
3rd	11 (9.9)	60 (54.1)
2nd	10 (10.5)	46 (48.4)
Top	16 (15.4)	61 (58.7)
Median income quartile:		
Lowest	17 (11.1)	76 (49.7)
3rd	18 (12.3)	82 (56.2)
2nd	15 (9.7)	82 (52.9)
Top	17 (11.6)	83 (56.8)
Charlson Index score		
0	51 (10.8)	247 (52.1)
1–2	14 (13.5)	64 (61.5)
3 or Greater	Less than 5 —	12 (54.5)
Tumor size (cm):*		
4 or Less	52 (12.0)	245 (56.3)
Greater than 4	12 (9.2)	61 (46.6)
Treatment yr:		
1991	Less than 5 —	Less than 5 —
1992	Less than 5 —	8 (57.1)
1993	Less than 5 —	Less than 5 —
1994	Less than 5 —	19 (52.8)
1995	Less than 5 —	17 (54.8)
1996	Less than 5 —	19 (47.5)
1997	Less than 5 —	11 (40.7)
1998	Less than 5 —	14 (43.8)
1999	9 (20.0)	25 (55.6)
2000	12 (10.6)	62 (54.9)
2001	17 (13.0)	73 (55.7)
2002‡	11 (9.9)	70 (63.1)
US Census region:*,†		
Midwest	11 (7.4)	82 (55.4)
Northeast	Less than 5 —	87 (65.9)
South	6 (8.5)	40 (56.3)
West	49 (19.7)	114 (45.8)
SEER registry:*,†		
Connecticut	Less than 5 —	47 (66.2)
Detroit	10 (10.4)	46 (47.9)
Hawaii	Less than 5 —	Less than 5 —
Iowa	Less than 5 —	36 (69.2)
New Mexico	Less than 5 —	9 (64.3)
Seattle	6 (18.2)	16 (48.5)
Utah	Less than 5 —	10 (38.5)
Atlanta	Less than 5 —	11 (52.4)
Rural Georgia	0	Less than 5 —
Kentucky	Less than 5 —	20 (66.7)
Louisiana	Less than 5 —	8 (42.1)
New Jersey	Less than 5 —	40 (65.6)
California	40 (23.3)	75 (43.6)

* Frozen section IPC $p < 0.05$.
† Gross IPC $p < 0.05$.
‡ Includes a small number of patients from 2003.

TABLE 3. *Provider characteristics by receipt of intraoperative pathological gross or microscopic consultation at radical nephrectomy*

	No. Gross IPC (%)	No. Frozen section IPC (%)
Av annual radical nephrectomy case vol quartile (No. cases):		
Top (6 or greater)	601 (11.1)	646 (11.9)
Lower 3 (less than 6)	143 (9.6)	197 (13.2)
Primary specialty:		
Urologist	339 (9.7)	377 (10.8)
Nonurologist	16 (15.4)	15 (14.4)
Degree type:		
M.D.	346 (9.9)	375 (10.7)
D.O.	7 (7.0)	16 (16.0)
Medical school graduation yr:*		
Before 1960	13 (12.6)	7 (6.8)
1960–1969	112 (14.4)	77 (9.9)
1970–1979	109 (9.2)	128 (10.8)
1980–1989	93 (8.2)	128 (11.3)
1990 or After	24 (6.7)	39 (10.9)
Practice structure:†		
Solo	85 (11.6)	62 (8.4)
2 Practitioners	39 (10.3)	31 (8.2)
Group	177 (9.5)	220 (11.8)
Other	54 (8.5)	79 (12.4)

* Gross IPC $p < 0.05$.
† Frozen section IPC $p < 0.05$.

similar across providers, eg surgeons, pathologists and hospitals, in a given region, yielding geographic variation similar to that reported in this study.[7,15] In the absence of new scientific evidence the observed geographic trends are likely to remain stable with time.

It is notable that we observed geographic variation for the use of frozen section during partial nephrectomy, which is a clinical scenario in which the rationale for IPC is more clearly defined. In this setting some authorities advocate intraoperative frozen section evaluation to ensure negative parenchymal margins at tumor excision.[4,5] Despite this compelling rationale empirical data suggest that IPC rarely changes intraoperative decision making.[4,5] Moreover, given the typically scant tissue available for review, reliable pathological interpretation remains a substantial challenge.[1,3,16] Therefore, even for partial nephrectomy the use-

TABLE 4. *Provider characteristics by receipt of intraoperative pathological gross or microscopic consultation at partial nephrectomy*

	No. Gross IPC (%)	No. Frozen Section IPC (%)
Av annual partial nephrectomy case vol quartile (No. cases):		
Top (2 or greater)	48 (11.2)	227 (53.2)
Lower 3 (less than 2)	19 (11.0)	96 (55.5)
Primary specialty		
Urologist	47 (12.3)	210 (55.1)
Nonurologist	Less than 5 —	Less than 5 —
Degree type:		
M.D.	48 (12.6)	212 (55.5)
D.O.	Less than 5 —	Less than 5 —
Medical school graduation yr:*		
Before 1960	Less than 5 —	5 (71.4)
1960–1969	13 (15.7)	30 (36.1)
1970–1979	14 (10.4)	79 (58.5)
1980–1989	14 (12.4)	65 (57.5)
1990 or After	5 (11.6)	29 (67.4)
Practice structure:		
Solo	7 (11.3)	29 (46.8)
2 Practitioners	7 (21.9)	16 (50.0)
Group	21 (12.1)	99 (56.9)
Other	13 (10.9)	69 (58.0)

* Frozen section IPC $p < 0.05$

TABLE 5. *Patient characteristics independently associated with receipt of gross IPC at radical nephrectomy or frozen section IPC at partial nephrectomy*

	Gross IPC		Frozen Section IPC	
	OR	95% CI	OR	95% CI
Age at diagnosis:				
60–69 vs 80 or Older	0.98	0.77–1.26	1.84	1.01–3.35
70–79 vs 80 or Older	0.98	0.79–1.20	1.53	0.91–2.56
Female vs male sex*	1.21	1.02–1.44	1.17	0.78–1.75
Race/ethnicity:*,†				
Black vs white	0.92	0.64–1.32	0.54	0.25–1.17
Hispanic vs white	0.61	0.42–0.89	1.25	0.57–2.74
Other vs white	0.45	0.28–0.73	3.62	1.23–10.7
Marital status:*				
Married vs single	1.22	0.86–1.73	2.17	1.05–4.48
Other vs single	0.90	0.62–1.30	2.31	1.06–5.04
Education quartiles	0.98	0.88–1.09	1.07	0.85–1.33
Median income quartiles*	1.18	1.09–1.29	1.08	0.89–1.32
Treatment yr:				
1993–1994 vs 1991–1992	0.83	0.62–1.11	0.86	0.28–2.62
1995–1996 vs 1991–1992	1.07	0.80–1.42	0.97	0.33–2.83
1997–1998 vs 1991–1992	0.93	0.69–1.25	0.74	0.25–2.21
1999–2000 vs 1991–1992	0.96	0.74–1.26	1.13	0.42–3.07
2001–2002 vs 1991–1992	0.75	0.56–0.99	1.27	0.48–3.38
US Census region:*,†				
Midwest vs West	0.57	0.47–0.69	1.90	1.20–3.03
Northeast vs West	0.26	0.20–0.35	2.35	1.44–3.84
South vs West	0.19	0.12–0.28	1.34	0.730–2.47
Charlson Index score:				
0 vs 3 or Greater	0.81	0.54–1.22	0.78	0.31–1.95
1–2 vs 3 or Greater	0.92	0.59–1.44	1.18	0.44–3.19
Tumor size				
4 cm or Less vs greater than 4	1.02	0.87–1.20	1.58	1.04–2.4

* Overall variable association with gross IPC during radical nephrectomy $p < 0.05$.
† Overall variable association with frozen section IPC during partial nephrectomy $p < 0.05$.

fulness of frozen section IPC is controversial and consequently its use tends to vary based on geography.

Frozen section IPC during partial nephrectomy was more common in patients with tumors 4 cm or less. This is potentially surprising, insofar as concerns related to the adequacy of resection margins are ostensibly greatest in patients with larger tumors. This seemingly paradoxical finding may in part reflect anatomical constraints encountered during partial nephrectomy for kidney tumors more than 4 cm. Namely larger renal masses may more frequently be juxtahilar in location and/or intimately adjacent to vascular or excretory structures and such anatomical complexities can make it difficult, if not impossible, to safely obtain sufficient tissue for intraoperative assessment of margin status.[5] Alternatively cases involving patients with larger tumors may be more frequently performed by experienced surgeons who request fewer frozen section consultations. The more frequent use of frozen section IPC in patients with smaller tumors may also be indicative of surgeon attempts to distinguish benign from malignant lesions since this may influence the aggressiveness of resection at the tumor base. Finally, patients with larger tumors may have more frequently had mandatory indications for partial nephrectomy, whereby the emphasis on preserving normal renal parenchyma precludes frozen section IPC. Irrespective of the underpinnings the implications of these data may become apparent only when we better understand the influence, if any, of frozen section IPC on long-term cancer control following partial nephrectomy.

The association between race/ethnicity and frozen section use during partial nephrectomy warrants further investigation. It seems unlikely that race itself is necessarily connected with trends in IPC use during kidney cancer surgery. Instead, the observed association with race/ethnicity implies the need to consider how race, through its association with access to care and socioeconomic status, patterns exposures to other determinants of IPC, including disease severity, provider choice and/or geographic residence.[17] Likewise the observed associations with income (gross IPC during radical nephrectomy) and marital status (frozen section IPC during partial nephrectomy) may also reflect the influence of socioeconomic position, insurance status and/or family preference on surgical practice patterns.

Gross IPC was requested during 11% percent of radical nephrectomies and its use was strongly associated with geographic region. Patients from the West had a 41% to 83% greater likelihood of receiving gross IPC during radical nephrectomy than patients from other United States Census regions. The considerable geographic variation implicates physician practice style and/or institutional tradition as potentially major determinants of demand for this service.[1,3] Moreover, the usefulness of gross IPC during radical nephrectomy is questionable. To clarify, gross IPC is requested to confirm the presence of a lesion in the extirpated specimen and, therefore, it is unlikely to meaningfully influence patient care, particularly given the almost universal use of preoperative cross-sectional imaging. Although details of the clinical context (unavailable from claims data) may clarify the indications in some cases, this practice arguably contributes to increased health care costs with an average Medicare charge for gross IPC (CPT 88329) in 2003 dollars of $27 without providing patient or population level benefits. Accordingly data supporting the clinical value of such consultations are needed to justify this expenditure.

Although we provide preliminary data, future studies are needed to better define the relative contribution of patient vs

provider factors, ie surgeons, pathologists and hospitals, with respect to IPC use during kidney cancer surgery. Our descriptive analyses revealed variations in IPC based on broadly defined surgeon attributes, including medical school year of graduation and practice structure. However, our analyses did not empirically evaluate whether these trends reflect differences in patients with kidney cancer or differences in the practice styles of their providers.

The implications of our findings are admittedly limited by an absence of detailed clinical information in the SEER-Medicare data set. To clarify, it would be easier to place our findings in context if, for instance we knew whether frozen section during partial nephrectomy was requested for diagnostic confirmation, assessment of margin status or histological assessment of a tumor adjacent to the renal pelvis. Likewise the potential value of frozen section consultation during radical nephrectomy is more easily understood in the context of concurrent clinical data specifying the presence of significant regional lymphadenopathy, a cystic rather than solid primary tumor and/or a mass abutting or involving the renal pelvis. As a corollary to the limited clinical data, we also had no information on patient or family preference for gross or frozen section consultations. It is entirely possible that many IPCs were requested in response to patient or family desire to receive preliminary pathological information on the day of surgery.

Another limitation of our study is that current SEER-Medicare data reflect practice patterns only for cases diagnosed through 2002. More recent data may reveal different use patterns for gross and frozen section IPC, particularly given the increasing role of laparoscopy in the surgical management of kidney cancer. The generalizability of our findings is also restricted to the extent that our sample was limited to patients who were 66 years or older and who had traditional fee for service Medicare coverage. As a result, our findings may not necessarily reflect surgical practice patterns in younger populations. However, an age threshold of 65 years is unlikely to be a biologically or clinically meaningful inflection point for the surgical treatment of patients with renal cell carcinoma. Therefore, we do not anticipate systematic differences in the use of IPC between Medicare beneficiaries and younger populations. Finally, our findings are based on an administrative claims data set, of which the reliability is limited by the accuracy of coding practices. In particular underreporting and misclassification of outcomes are possible in the current analysis. Also, we defined high volume surgeons empirically rather than based on existing criteria. Alternative volume thresholds may have yielded different conclusions.

CONCLUSIONS

Intraoperative pathological consultations are common during partial or radical nephrectomy performed for kidney cancer. The use of IPC in this setting varies with time, across geographic regions, and based on patient demographic factors and broadly defined provider characteristics. Future studies should explore the association between frozen section IPC and long-term cancer control following partial nephrectomy. Given its use in more than 10% of cases, the clinical benefits derived from the expense of gross IPC following radical nephrectomy should be examined.

Abbreviations and Acronyms

CMS	=	Centers for Medicare and Medicaid Services
CPT	=	Current Procedural Terminology
IPC	=	intraoperative pathological consultation
SEER	=	Surveillance, Epidemiology and End Results

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EDITORIAL COMMENT

These authors have analyzed trends in the use of IPC during partial or radical nephrectomy in the United States from 1991 to 2002. This study using the SEER-Medicare linked database reflects the practice patterns of high volume surgeons caring for Medicare beneficiaries with renal cell carcinoma. The data reveal a varied practice pattern across time, geographic regions and patient demographics. Given that no evidence based guidelines exist for IPC use during kidney cancer surgery, the results reflect this fact. Also, the cohort studied in this particular time frame of 1991 to 2002 revealed that less than 5% of the cases were performed laparoscopically. Since 2002, surgical trends in the treatment of renal cell carcinoma have been transitioning from an open approach to a laparoscopic approach. Future practice patterns in the use of IPC may likely reflect this transition in surgical technique, especially since frozen pathology is often obtained in laparoscopic surgery, particularly during laparoscopic partial nephrectomy.

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