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Patterns of Care for Kidney Cancer in Minority Serving Hospitals

Lina Posada Calderon[1], Bashir Al Hussein Al Awamlh[2], Aleem Islam Khan[3], Leonardo D. Borregales[4], Johannes C van der Mijn[5,6], Jonathan E Shoag[7] and Douglas S Scherr[1]*

[1]*Department of Urology, Vanderbilt University Medical Center, Nashville, USA*

[2]*Department of Urology, Vanderbilt University Medical Center, Nashville, USA*

[3]*Department of Urology Lennox Hill Hospital, USA*

[4]*Division of Urology, Mount Sinai Medical Center, USA*

[5]*Department of Pharmacology, New York Presbyterian Hospital, Weill Cornell Medicine, USA*

[6]*Department of Medical Oncology, Amsterdam University Medical Center, The Netherlands*

[7]*Department of Urology, University Hospitals Cleveland Medical Center, Case Western Reserve University School of Medicine, USA*

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***Corresponding author:** Douglas S Scherr, Department of Pharmacology, Weill Cornell Medical College, 1300 York Avenue, Room E-409, New York, USA Email: dss2001@med.cornell.edu

Abstract

Background: Minority serving hospitals (MSH) serve the highest percentage of black and Hispanic patients. Independent of patient factors, treatment at MSH results in lower quality of care. As minorities reportedly die more from kidney cancer, understanding the origin of the disparity is crucial to addressing it. Here, we assess whether kidney cancer care differs between MSH and non-MSH.

Patients and Methods: Using the National Cancer Data Base (NCDB) from 2004 to 2015 we identified 240,527 adult patients diagnosed with non-metastatic kidney cancer. MSH were defined as the top 10% facilities serving the highest percentage of Black and Hispanic patients. We used the odds of undergoing surgery for kidney cancer (partial or radical nephrectomy) and time from diagnosis to surgery, to measure the impact of treatment at MSH.

Results: 19,701 (8.2%) patients were treated at MSH and 220,826 (91.8%) at non-MSH of which 15,807 (80.2%) and 181,359 (82.1%) underwent renal surgery, respectively, p<0.001. In multivariable analysis, patients treated at MSH had lower odds of undergoing renal surgery as compared to patients treated at non-MSH, Odds Ratio (OR) 0.93, 95% CI 0.89 to 0.98; p=0.002. There was no difference in time from diagnosis to surgery, mean difference -0.47 days, 95% CI -1.38 to 0.44, p=0.307. In subset analysis, white and Hispanic patients had lower odds undergoing surgery when treated at MSH, OR 0.88, 95% CI 0.82 to 0.94 and OR 0.88, 95% CI 0.79 to 0.97, respectively. Further, when MSH were low-volume facilities, patients also had lower odds of undergoing surgery, OR 0.76, 95% CI 0.72 to 0.81; p<0.001.

Conclusions: Treatment at MSH is associated with a lower likelihood of receiving surgery for kidney cancer. This effect is modified by race/ethnicity and by facility volume, suggesting a combination of health access, patient, and facility factors contribute to racial disparities in kidney cancer care.

Keywords: Kidney cancer; Nephrectomy; Healthcare disparity; Minority groups

Introduction

Kidney cancer is the ninth most common cancer in the United States and the third most common urologic malignancy [1]. The increasing use of cross-sectional imaging has resulted in more kidney cancers being diagnosed, particularly among Black and Hispanic patients [2,3]. Recent work has shown that black patients are diagnosed with kidney cancer at a younger age and have higher mortality rates than their white counterparts [2-6]. While somewhat less studied, similar treatment and outcome disparities have been shown for Hispanic patients [7, 8]. The etiology of these discrepant outcomes is uncertain, with socioeconomic status, access to care, and tumor biology all potentially contributing [9].

While there are multiple determinants of outcomes after oncologic surgery, the facility where surgery takes place has a substantial impact on outcomes [10,11]. For instance, it has been shown that high volume facilities are more likely to perform partial nephrectomies as compared radical nephrectomies in lower volume centers, for stage T1 and T2 kidney cancer. In addition to facility volume, increasing attention has been focused on care delivered at minority-serving hospitals (MSH), defined as hospitals where a large proportion (top decile) of patients are Black or Hispanic [12-14]. Studies have demonstrated that treatment at MSH is associated with lower odds of receiving definitive treatment in prostate cancer, with concomitant inferior outcomes [14]. Herein, we sought to investigate the association between treatment at MSH and treatment trends in kidney cancer in an attempt to understand the complex relationship between race, healthcare access, and treatment decisions.

Materials and Methods

Study design and population

Data was acquired through the National Cancer Data Base (NCDB), an oncology registry sponsored by the American College of Surgeons and the American Cancer Society. NCDB was designed to identify and follow patients with neoplasms in Commission on Cancer (CoC)-accredited facilities [15]. More than 1,500 facilities are accredited and submit newly diagnosed cases to the NCDB, accounting for a 67-72% of all cancer cases in the United States [16,17]. In the period from 2012 to 2014, kidney and renal pelvis cases reported in the NCDB represented a 77.8% of case coverage [17]. Using the topography code for kidney (C.649) [18], we identified 240,527 patients 18 years or older diagnosed with kidney cancer between 2004 and 2015. Only patients who had their treatment exclusively at one facility were included. Patients with missing unknown information on clinical tumor stage and surgical procedure, and those with metastatic disease at time of diagnosis were excluded.

Exposure and outcomes

Our exposure of interest was treatment at MSH. Facilities in the top 10% for the proportion of Black and Hispanic patients treated were defined as MSHs. This definition was based on previous publications to create a comparable measure [12-14]. All hospitals that did not fall into the category of MSH were classified as non-MSH. The primary outcome was undergoing renal surgery (partial or radical nephrectomy). Patients were censored at the occurrence of renal surgery or after 180 days of the index diagnosis. Patients on active surveillance, receiving local destruction or excision of the tumor or other non-surgical treatment were defined as not undergoing surgery. The secondary outcome was time to renal surgery, defined as time from diagnosis to surgery.

Covariates

We included age, sex, race/ethnicity (categorized as white non-Hispanic, black non-Hispanic, Hispanic and other/unknown) and Charlson Comorbidity Index (CCI). Additionally, clinical T stage, CoC facility type, socioeconomic variables (median household income per patient's ZIP code, primary payer, percentage of adults with no high-school diploma in patient's ZIP code and county type), and distance from hospital were included. Year of diagnosis and facility case load volume (categorized as low-volume and high-volume facility) were included to account for variation in treatment over time and across high and low volume facilities, respectively [10]. Facility case load was defined as number of kidney cancer patients treated at each institution during the study period and dichotomized as low-volume and high-volume according to the 85th percentile of number of patients treated per facility. The 85th percentile cutoff was chosen as it allowed a similar distribution between the groups [11].

Statistical Analysis

The chi-square or t-test were used to compare categorical and continuous variables, respectively. Both univariate and multivariable logistic regression were used to assess the effect of treatment at MSH versus non-MSH on receipt of renal surgery. Multivariable models were adjusted for age, sex, race/ethnicity, clinical T stage, type of facility, household income, primary payer, percent of adults with no high-school education in patient's ZIP code, rurality, distance to hospital, year of diagnosis and facility case-load volume. Variables were incorporated into the model a-priori independent of univariate p-values. Subgroup analysis was also performed stratified by disease state. Interactions between hospital type (MSH and non-MSH) and race/ethnicity (white non-Hispanics, black non-Hispanics, and Hispanics) and facility case load volume (low-volume and high-volume facility) were assessed by including an interaction term (Race/ethnicity x MSH) and (Facility case load volume x MSH) into a multivariate model. All statistical analyses were performed using R studio version 3.5.1. [19]. All reported p-values are two sided with statistical significance evaluated at the 0.05 alpha level.

Results

A total of 240,527 patients were included for analysis, 19,701 (8.2%) of whom were treated at MSHs and 220,826 (91.8%) at non-MSHs. Patients presenting to MSH were younger, and more likely to be female, Black or Hispanic than those presenting to non-MSHs. Patients presenting to MSHs had higher clinical T stage and MSHs tended to be lower volume centers than non-MSHs (Table 1). In MSHs, a total of 15,807 (80.2%) patients underwent renal surgery, while 3,894 (19.8%) did not. Conversely, in non-MSHs a total of 181,359 (82.1%) underwent surgery versus 39,467 (17.9%) who did not, $p<0.001$ (Table 2). In adjusted analysis, patients treated at MSH had an odds ratio (OR) of 0.92 (95% CI 0.88 to 0.96; $p<0.001$) of undergoing surgery as compared to those treated at non-MSHs (Table 3). The mean time to surgery from diagnosis was shorter (27.55 ± 51.1 days) in non-MSHs compared to MSHs (30.49 ±59.2), $p<0.001$ (Table 2). In adjusted analysis, the mean difference in treatment times was -0.56 days (95% CI -1.46 to 0.35; p=0.229) (Table 3).

We observed a significant interaction between race/ethnicity and MSH in a multivariable model incorporating an interaction term for race/ethnicity and MSH status for receipt of renal surgery (p-interaction <0.05) and time to renal surgery (p-interaction<0.05). In the subgroup analysis by race/ethnicity, within white non-Hispanic patients, treatment at MSH was significantly associated with not receiving surgical treatment (OR 0.88, 95% CI 0.82 to 0.94; $p<0.001$) and with a mean difference of -2.38 days (95% CI -3.68 to -1.08; $p<0.001$) in time to renal surgery. Among Black non-Hispanics, both receipt of surgery and time to surgery were not significantly different in MSHs as compared to non-MSHs. Hispanic patients treated at an MSH had an OR of 0.88 (95% CI 0.79 to 0.97; p=0.012) of receiving renal surgery and no significant difference in time to renal surgery compared to non-MSH (Figure 1).

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Table 1: Baseline characteristics in patients in MSH and non-MSH.

	MSH (n=19,701)	Non-MSH (n=220,826)	P value
Age[a]	60.9 ± 13.2	62.5 ± 13.0	<0.001
Sex		s	
Male	11,648 (59.1%)	135,988 (61.6%)	<0.001
Female	8,053 (40.9%)	84,838 (38.4%)	
Race/ethnicity			
White non-Hispanic	7,360 (37.4%)	171,592 (77.7%)	<0.001
Black non-Hispanic	5,357 (27.2%)	22,077 (10.0%)	
Hispanic	5,706 (29.0%)	9,291 (4.2%)	
Other/Unknown	1,278 (6.5%)	17,866 (8.1%)	
CCI			
0	13,557 (68.8%)	151,343 (68.5%)	0.113
1	4,342 (22.0%)	50,114 (22.7%)	
2+	1,181 (6.0%)	13,716 (6.2%)	
T stage			
T1	15,171 (77.0%)	173,433 (78.5%)	<0.001
T2	2,747 (13.9%)	28,203 (12.8%)	
T3	1,611 (8.2%)	17,797 (8.1%)	
T4	172 (0.9%)	1,393 (0.6%)	
Facility type			
Community cancer program	1,468 (7.5%)	16,206 (7.3%)	<0.001
Comprehensive community cancer program	6,183 (31.4%)	91,665 (41.5%)	
Academic/Research program	9,463 (48.0%)	90,462 (41.0%)	
Integrated network cancer program	2,587 (13.1%)	22,493 (10.2%)	
Median household income per ZIP code			
<38,000	6,206 (31.5%)	36,618 (16.6%)	<0.001
38,000 - 47,999	4,295 (21.8%)	51,677 (23.4%)	
48,000 - 62,900	4,763 (24.2%)	59,865 (27.1%)	
>= 63,000	4,299 (21.8%)	70,944 (32.1%)	
Primary payer			
Not insured	1,978 (10.0%)	5,370 (2.4%)	<0.001
Private insurance	7,096 (36.0%)	97,794 (44.3%)	
Medicaid	2,254 (11.4%)	10,917 (4.9%)	
Medicare	7,727 (39.2%)	100,860 (45.7%)	
Other government	180 (0.9%)	2,876 (1.3%)	
Unknown	466 (2.4%)	3,009 (1.4%)	
Percentage of adults with no High School degree per ZIP code			
>21%	8,304 (42.2%)	33,739 (15.3%)	<0.001
13% - 20.9%	5,110 (25.9%)	58,363 (26.4%)	
7% - 12.9%	3,977 (20.2%)	74,139 (33.6%)	
<7%	2,178 (11.1%)	52,966 (24.0%)	
County type			
Metropolitan	18,023 (91.5%)	175,955 (79.7%)	<0.001
Urban	1,192 (6.1%)	33,809 (15.3%)	

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Rural	160 (0.8%)	4,432 (2.0%)	
Unknown	326 (1.7%)	6,630 (3.0%)	
Mean distance from hospital (miles)[a]	22.4 ± 81.4	34.3 ± 107.1	<0.001
Year of diagnosis			
2004 - 2007	2,897 (14.7%)	38,548 (17.5%)	<0.001
2008 - 2011	7,151 (36.3%)	81,357 (36.8%)	
2012 - 2015	9,653 (49.0%)	100,921 (45.7%)	
Facility case load volume[b]			
Low-volume facility	108,997 (49.4%)	10,941 (55.5%)	<0.001
High-volume facility	111,829 (50.6%)	8,760 (44.5%)	

a) Continuous variables presented as mean ± standard deviation (SD).
b) Number of patients treated at each institution during the study period and dichotomized using the 85th percentile as cut-off

Table 2: Renal surgery rate and mean time to renal surgery in MSH and non-MSH.

	MSH (n=19701)	Non-MSH (n=220826)	P value
Receipt of renal surgery			
Renal surgery	15,807 (80.2%)	181,359 (82.1%)	<0.001[a]
No renal surgery	3,894 (19.8%)	39,467 (17.9%)	
Active surveillance	232 (1.2%)	2,814 (1.3%)	
Local treatment	1,218 (6.2%)	18,476 (8.4%)	
Other treatment	576 (2.9%)	4,594 (2.1%)	
No surgical treatment	1,868 (9.5%)	13,583 (6.2%)	
Mean time to renal surgery (days)[b]	30.49 ± 59.2	27.55 ± 51.1	<0.001

a) p value obtained with chi-square comparing renal surgery versus no renal surgery.
b) Continuous variable presented as mean ± standard deviation (SD).

Table 3: Adjusted and unadjusted association between hospital type and the receipt of renal surgery and time to renal surgery.

	Receipt of renal surgery			Time to renal surgery		
	OR	**95% CI**	**p value**	**Mean difference**	**95% CI**	**p value**
Unadjusted	0.88	0.85 to 0.92	<0.001	2.93	2.09 to 3.78	<0.001
Adjusted[a]	0.92	0.88 to 0.96	<0.001	-0.56	-1.46 to 0.35	0.229

a) Model adjusted for: age, sex, race/ethnicity, clinical T stage, type of CoC facility, median household income per patient's ZIP code, primary payer, percent of adults with no high-school education in ZIP code, county type, distance to hospital, year of diagnosis and facility case-load volume.

Similarly, when incorporating the interaction term for facility case load volume and MSH, facility case-load volume was an effect modifier for the relationship between hospital type MSH and the likelihood of undergoing renal surgery (p-interaction <0.05) as well as time to renal surgery (p-interaction < 0.05). Within low-volume facilities, patients treated at MSH had a lower likelihood of receiving renal surgery (OR 0.76, 95% CI 0.72 to 0.81; p<0.001) and a longer time to surgery (mean difference of 3.21 days, 95% CI 2.02 to 4.40; p<0.001) compared to non-MSH. On the other hand, within high-volume facility hospitals, patients treated at MSH had a borderline higher likelihood of receiving renal surgery (OR 1.07, 95% CI 1.00 to 1.15; p=0.047) and a shorter time to renal surgery (mean difference of -4.08 days, 95% CI -5.48 to -2.69; p<0.001) compared to non-MSH (Figure 1).

In the subgroup analysis stratified by tumor stage, within cT1 stage, treatment at MSH had no effect on receiving renal surgery. Within cT2, cT3 and cT4 stage, treatment at a MSH resulted in lower likelihood of receiving renal surgery (OR 0.75, 95% CI 0.64 to 0.88, p<0.001; OR 0.64, 95% CI 0.53 to 0.77, p<0.001; and OR 0.58, 95% CI 0.39 to 0.86, p=0.007; respectively) compared to non-MSH. Time to treatment was not significantly different for MSH in any stage (Figure 1).

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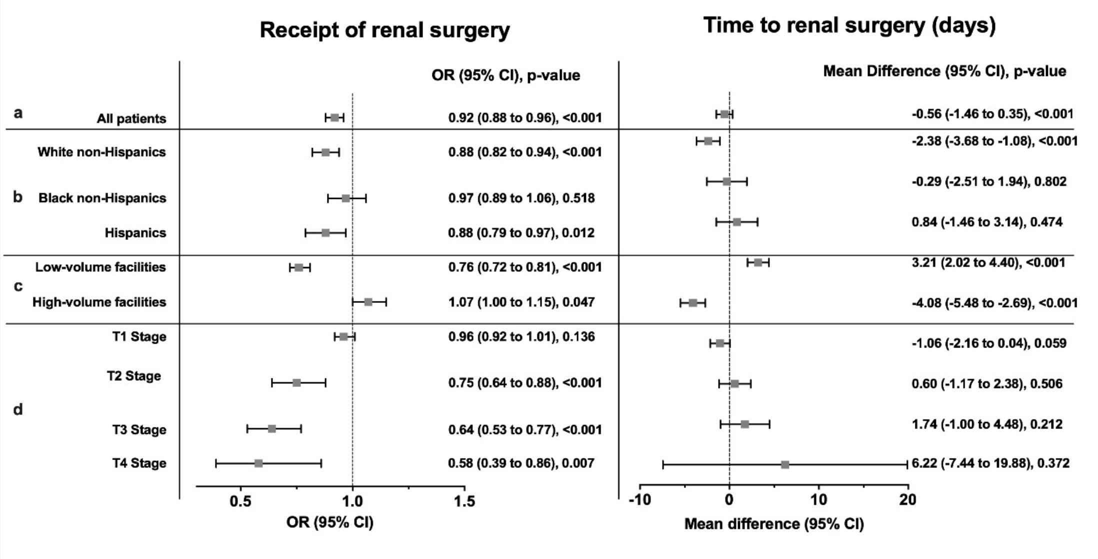

Figure 1: Odds ratio for receipt of renal surgery and time to renal surgery in MSH compared to non-MSH in a) all patients, b) stratified by Race/ethnicity, c) Facility case load volume and d) clinical T stage. Each model is adjusted for: age, sex, clinical T stage, type of CoC facility, median household income per patient's ZIP code, primary payer, percent of adults with no high-school education in ZIP code, county type, distance to hospital, year of diagnosis and facility case-load volume.

Discussion

To our knowledge, this is the first study aimed at investigating how race/ethnicity and the type of facility where patients are being treated interact, leading to a discrepancy in kidney cancer treatment. In this large data base, we found that treatment at MSH was associated with a lower likelihood of receiving renal surgery while no significant association with time to surgery. Additionally, we found the effect of MSH on predicting a lower likelihood of receiving renal surgery to be significant only within white non-Hispanic and Hispanic patient population and within low-volume hospitals. Moreover, the effect of treatment at MSH was even more significant with increasing clinical T stage.

Racial disparity in treatment and outcomes in kidney cancer has been attributed to several factors. Genetic differences, such as a lower frequency of the tumor suppression gene Von Hippel-Lindau (VHL) [20], differences in access to health care, treatment patterns, quality of health care received and patient's attitudes and beliefs towards treatment have all been implicated [9]. While surgical resection remains the standard of care in non-metastatic RCC [21], nephrectomy has consistently been reported to be lower in the black patient population [4-6]. In our study, we show patients treated at a MSH have a significantly lower likelihood of receiving renal surgery, an alarming trend that represents a discrepancy in treatment that could partly explain the survival disparity [2, 4-6]. Although time to treatment has been reported to have no effect on disease recurrence and to have a questionable effect in overall survival in RCC [22], it was used as a proxy for quality of care provided. However, treatment at MSH did not significantly affect the time to surgery.

Interestingly, when analyzing the effect stratified by race/ethnicity, only the white non-Hispanic and Hispanic patient population had lower odds of receiving renal surgery in MSH. Some studies have assessed mortality in patients treated in equal-access and single-payer health care delivery institutions and they found no significant differences in survival between races [23, 24]. Additionally, quality measures have been used to determine that within the same hospital, minorities receive the same quality of care than their white counterparts and that disparities are the result of differences in the facilities where minorities are treated [25]. In this context, our findings could be explained by a general lower quality of care in hospitals where minorities seek care. White patients, although not minorities, could be subjected to lower treatment standards in MSH in as much the same way as non-white patients, as quality of care received may depend more on barriers to health care than on race itself. It is possible, that black non-Hispanics, on the other hand, could be receiving a lower quality of care regardless of the institutions of treatment since additional factors such as different attitudes towards health-related issues and how and when they seek care may influence their treatment outcomes in addition to the effect the institution where they are treated might have [9]. This may suggest the discrepancies in care

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extend well beyond race and that the disparity reflects the socioeconomic characteristics of the institution rather than the racial makeup alone.

Facility volume is well-known to affect outcomes after major surgery [26,27], with high-volume facilities being independently associated with lower rates of postoperative complications and improved outcomes after nephrectomy [28]. This relationship between facility volume and outcomes has been shown so consistently that multiple health initiatives have advocated for patients undergoing complex surgical procedures to be redirected to higher volume hospitals to improve quality [29]. From our analysis, we see how the effect of being treated at a MSH is more pronounced in low-volume hospitals, as these facilities may be more susceptible to a lower quality of care provided by MSH. Additionally, minorities are more likely to seek care at low volume rather than high-volume facilities regardless of travel time [30]. These could further explain how the discrepancy in RCC could be due to a socioeconomic difference rather than a strict racial difference.

We included a subset analysis by clinical T stage since it is one of the main elements that guides treatment decisions. In clinical T1 Stage, receipt of renal surgery was not significantly different between MSH and non-MSH. We hypothesize this could be explained by a greater percentage of active surveillance in non-MSH, since these patient populations may have better access to repeat imaging and follow-up visits. Interestingly, the odds of receiving renal surgery were lower for increasing T stage (Figure 1), with the lowest odds ratio seen in cT4. Nephrectomy for higher disease stage becomes more complex, with thrombectomy increasing both morbidity and mortality and requiring a multidisciplinary team for management. MSHs may not be equipped with the personnel and machinery to undergo these complex procedures. Additionally, minorities present with a unique set of comorbidities that may deem them unfit to undergo higher risk procedures.

From our analysis, we may infer the disparity in kidney cancer is explained not only by race itself but also by differences in socioeconomic status and the facilities where patients with lower access to health care receive treatment. In order to diminish the disparities in care at MSH it is imperative to regionalize care of kidney cancer to higher quality and higher volume centers, especially in the context of higher stage disease.

There are some limitations to our study that require consideration. First, the observational nature of the analysis cannot exclude residual confounding. Second, our study population excluded patients being treated at more than one facility and presenting metastatic disease and caution should be taken when extrapolating this analysis. Lastly, patients under active surveillance and receiving local treatment were analyzed as not receiving nephrectomy, even though some patients might have been treated adequately if they were fit for these strategies or were poor surgical candidates. Renal surgery performed after 180 days also fell into the no renal surgery group as to control for outliers in the time to treatment analysis.

Conclusions

Patients with non-metastatic renal cancer are less likely to receive renal surgery when treated at MSH. In subset analysis by race/ethnicity and facility volume, the likelihood of receiving renal surgery in MSH is lower only in white non-Hispanics and Hispanics, and in low-volume facilities showing how the disparity can be attributed to socioeconomic discrepancies in addition to race alone. In large part, this requires careful regionalization of care to high-quality, high-volume centers. Future direction should aim at understanding the reason for the lower quality of health in these institutions. Additionally, this finding should encourage health care related professionals to find a way to ensure minorities receive equal quality of care.

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