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Urologic Oncology: Seminars and Original Investigations ▮ (2017) ▮▮▮–▮▮▮

UROLOGIC ONCOLOGY

Original article

Regionalization of radical cystectomy in the United States

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Received 10 October 2016; received in revised form 19 January 2017; accepted 22 March 2017

Abstract

Purpose: Radical cystectomy (RC) has become increasingly regionalized to high-volume hospitals. Our objective was to describe changes in regional market concentration and the distribution of RCs among hospitals, and examine how these changes affect patient travel distance to surgery.

Materials and methods: We used the surveillance, epidemiology, and end results-Medicare database to identify patients who had RC for bladder cancer from 2001 to 2011. We defined RC market concentration within each Hospital Referral Regions (HRR) in surveillance, epidemiology, and end results using the Hirschman-Herfindhal Index. We measured straight-line patient travel distance to the nearest cystectomy provider hospital and used linear regression to evaluate the effect of market concentration on travel distance for surgery. We performed a similar analysis on patients who had laparoscopic cholecystectomy as a comparator.

Results: We identified 10,802 patients with bladder cancer who had RC. From 2001 to 2011, 40% of HRRs had a statistically significant increase in Hirschman-Herfindhal Index, 53% had no significant change and 7% had a statically significant decrease. The median patient travel distance increased significantly from 10.4 miles (interquartile range: 2.6–30.2) to 16 miles (interquartile range: 6.3–40.4, $P < 0.0001$). Patients who lived in a highly concentrated HRR had to travel significantly further than patients who lived in an unconcentrated HRR ($\beta = 37.5$, $P < 0.001$). These trends were not seen for laparoscopic cholecystectomy.

Conclusions: Between 2001 and 2011, RC became increasingly regionalized to a small group of hospitals with a resultant increase in regional RC market concentration and patient travel distance. The clinical consequences on these changes to patients who require RC are uncertain.

Keywords: Cystectomy; Health care quality, access, and evaluation; Travel; Urinary bladder neoplasms; Healthcare market

1. Introduction

An inverse association between hospital volume and perioperative mortality for complex surgical procedures was demonstrated more than a decade ago, prompting proposals to regionalize these operations to high-volume hospitals [1,2]. Subsequently, there has been a regionalization of several complex operations, such as pancreatectomy and esophagectomy, to high-volume hospitals [3–5]. Although regionalization has been mandated in some countries, trends in the United States appear to be market driven, secondary to patient demand, physician referral patterns, and availability of providers [6].

Although regionalizing complex cancer surgery to high-volume hospitals is associated with improved outcomes, it may also have implications for access to care. Regionalization of radical surgery for pancreatic, esophageal, colon, and rectal cancers was associated with increased patient travel distance over time, in proportion to the degree of regionalization [4].

Over 7,000 radical cystectomies (RCs) are performed in the United States each year, and the procedure is considered the gold-standard treatment for high-risk bladder cancer [7]. Despite this, RC continues to carry significant perioperative morbidity and mortality [8]. Similar to other complex cancer operations, patients who have cystectomy at high-

Funding: Regional.
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http://dx.doi.org/10.1016/j.urolonc.2017.03.026
1078-1439/

volume hospitals generally have better surgical outcomes, including lower mortality rate, shorter hospital length of stay, fewer complications, and are more likely to get a continent urinary diversion [1,9,10].

Although RCs have become increasingly concentrated at high-volume hospitals, the effect of this trend on patient access to the procedure is unclear [11,12]. Prior studies have described regionalization of RC, and other procedures, by defining hospital volume thresholds and observing shifts from low- to high-volume hospitals over time [4,12]. This approach requires the assignment of arbitrary volume thresholds and omits information about changes in the number of providers. It also ignores changes in the geographic distribution of hospitals that provide RC, which may have an important influence on patient travel distance and therefore access to care.

Our objective was to identify changes in the distribution of hospitals that provide RC, in the competitiveness of regional markets, and in patient travel distances. We hypothesized that there has been increasing regionalization of RC over time, reflected by a smaller number of hospitals performing the procedure, increasing inequality in the distribution of procedures across hospitals, and a greater concentration of RCs within regional tertiary care markets. We also hypothesized that as a result of increasing regionalization, patients are required to travel greater distances to reach a hospital that provides RC.

2. Methods

2.1. Data

We used the population-based surveillance, epidemiology, and end results (SEER)-Medicare database. The SEER registry collects all incident cancer cases in 18 geographic regions, encompassing nearly 30% of the population of the United States, and includes patient-level data on cancer characteristics and treatment type [13]. All patients residing in SEER aged 65 and older have linked Medicare billing claims that provide supplemental data on patient characteristics and health resource usage. The study was deemed exempt research by the Institutional Review Board of Memorial Sloan Kettering Cancer Center, and it was conducted in adherence with a Data Use Agreement from the National Cancer Institute.

2.2. Cohort

To evaluate regional health care markets, we identified Hospital Referral Regions (HRRs) within SEER. HRRs are regional health care markets where Medicare beneficiaries receive tertiary surgical care [14]. Of the 306 HRRs, 94 overlap with SEER regions. To maximize data completeness, we only included HRRs in which at least 75% of the resident population was within the boundaries of a SEER region. The geographic distribution of the population within each HRR was defined by 2000 census counts in ZIP Code Tabulation Areas (ZCTAs). Of the 94 HRRs with SEER overlap, 72 had at least 75% of their population within SEER boundaries and were included in the study (Supplemental Fig. 1). We varied this threshold between 70% and 90% and a similar number of HRRs met inclusion criteria.

In the SEER-Medicare dataset, we identified all patients aged 65 or older with a diagnosis of bladder cancer (ICD-9 diagnosis codes 188.0–188.0, 233.7, 236.7, and 239.4) who had RC at a hospital within an included HRR between 2001 and 2011 ($N = 9{,}769$). This cohort included patients who had RC for any indication.

2.3. Distribution of RCs

The distribution of RCs among all hospitals in the included HRRs was characterized using Lorenz curves, which have been used to describe the distribution of health care resources [15,16]. We used Lorenz curves to depict the cumulative percentage of radical cystecomies performed by X percentage of hospitals each year. The further the curve deviates from the 45° line from the origin, the less equal the distribution of procedures among hospitals.

A Gini coefficient quantifies the distribution of a Lorenz curve, and varies from 0 to 1 with higher values reflecting greater inequality. For our purposes, higher values of the Gini coefficient reflect greater regionalization of the procedure. We plotted Lorenz curves and estimated Gini coefficients to describe the distribution of cystectomies for each year of analysis.

2.4. Market concentration of RCs

We used the Hirschman-Herfindhal Index (HHI) to assess changes in regional cystectomy markets over time. The HHI is an econometric measure that estimates the amount of concentration (and presumed lack of competition) within a market [17]. We estimated the HHI for each HRR in each year based on all patients who had RC within the HRR, using a hospital's procedure volume to represent its share of the regional RC market. The HHI is calculated by summing the squared market shares of each participant in the market and varies from 0 to 1 with 0 representing perfect competition and 1 complete monopoly. For example, a HRR with 5 hospitals that each performed 20% of procedures has a HHI of $(0.2^2 + 0.2^2 + 0.2^2 + 0.2^2 + 0.2^2 + 0.2^2) = 0.2$. Alternatively, a HRR with 4 hospitals that each performed 5% of procedures and 1 that performed 80% has an HHI of $(0.05^2 + 0.05^2 + 0.05^2 + 0.05^2 + 0.8^2) = 0.74$. Federal agencies have defined a HHI < 0.15 as an unconcentrated market, $0.15 \leq$ HHI ≤ 0.25 as a moderately concentrated market, and HHI > 0.25 as a highly concentrated market [18].