



Radical Prostatectomy Trends in the United States: 1998 to 2011

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Abstract

Objective: To determine the incidence and distribution of radical prostatectomy (RP) in the United States over time.

Patients and Methods: We conducted a serial cross-sectional analysis of time trends using the Nationwide Inpatient Sample of adult men older than 45 years who underwent RP between January 1, 1998, and December 31, 2011.

Results: Weighted estimates revealed that 962,917 men underwent RP during the study period. The annual rate of RP remained relatively stable, from 1425 RPs per million in the period 1998 to 1999 to 1330 RPs per million in the period 2010 to 2011 (7% decrease; $P=.90$). The annual rate of open RP decreased from 1424 per million to 435 per million ($P<.001$), whereas the annual rate of minimally invasive RP increased from less than 1 per million to 895 per million ($P<.001$). Since 2006, hospitals providing open RP decreased by 18% (from 2288 to 1870; $P<.001$), whereas hospitals providing minimally invasive RP increased by 191% (from 341 to 993; $P<.001$). The median open RP caseload per hospital decreased by 7% (from 68 to 63; $P<.001$), whereas the median caseload for hospitals providing minimally invasive RP declined by 17% (from 122 to 101; $P<.001$). The hospitals providing fewer than 50 minimally invasive RPs per year increased from 12% to 26% (from 144 of 1240 to 3020 of 11,644; $P<.001$).

Conclusion: Per capita utilization of RP in the United States has remained stable from 1998 to 2011. Rapid expansion of the use of minimally invasive RP has reduced open RP utilization rates and median annual hospital caseload.

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Radical prostatectomy (RP) is one of the most scrutinized treatment options for men with prostate cancer. In recent years, there has been an impetus for active surveillance of low-risk, organ-confined prostate cancer on the basis of published data from randomized clinical trials that have called into question the utility of RP over watchful waiting, particularly in older men with comorbid conditions.^{1,2} Despite these data, multiple reports have indicated increasing use of RP in the United States.^{3,4} Some have postulated that this increase is due to the rapid expansion and regionalization of robotic surgical technology in the United States.^{3,5,6}

Despite these observations, 2 key concepts remain unaccounted for in these previously published studies. First, no study has yet defined the incidence rate of RP in the United States and how it has changed over time.

Although an increase in the total number of RPs may lead to the presumption that the use of RP is on the rise, such an increase must be examined in the context of the population at risk of prostate cancer surgery, or else the increase may not accurately reflect national trends. Second, although it is well documented that the use of RP has become more regionalized in the United States, with many patients receiving care at high-volume institutions, much less is known about the extent to which RP remains decentralized (ie, the clinical and demographic characteristics of patients who continue to receive their care from low-volume or intermediate-volume institutions).

In this context, we explored how these factors influenced the volume and distribution of RP in the United States over time. Using a serial cross-sectional analytic study design, we calculated the incidence rate of RP per million US adult

men older than 45 years over the past 2 decades. We believe that these data are indispensable to understanding RP utilization rates in the United States because any substantial change in the overall volume of RP and/or the relative utilization of open RP vs minimally invasive radical prostatectomy (MI-RP) could have important implications for clinical outcomes, health care costs, and the delivery of care to men with prostate cancer.

PATIENTS AND METHODS

Study Data

After receiving approval from the Mayo Clinic Institutional Review Board, we extracted data for the period from 1998 to 2011 from the Nationwide Inpatient Sample (NIS) files of the Healthcare Cost and Utilization Project within the US Agency for Healthcare Research and Quality. The NIS contains discharge data both at the patient level and at the hospital level from states that participate in the Healthcare Cost and Utilization Project. Comprising data from approximately 1000 US hospitals annually, the NIS is designed as a stratified 20% representative sample of all nongovernment hospitals nationwide.⁷ The criteria that are used for sampling hospitals within the NIS include 5 variables: teaching status, urban or rural location, geographic region, hospital ownership, and patient volume. The national estimates for the entire US population of patients undergoing RP must be weighted according to this complex sampling scheme of observations obtained at the patient level and at the hospital level. Each individual record within the NIS contains up to 25 diagnosis and procedure codes and includes all the claims for each selected hospital, regardless of payer or insurance status.

Identification of Patients Undergoing RP and Calculation of RP Rates

Patients undergoing RP were identified using the *International Classification of Diseases, 9th Revision (ICD-9)* procedure code 60.5 for RP. A claim was classified as a laparoscopic RP when the procedure code 54.21 or 54.51 appeared in the record or as a robotic RP when the procedure code was 17.4x. Because the NIS is assembled as a 20% stratified random sample of all US hospitals, the population receiving treatment in these hospitals

was a 20% random sample of the US population. Therefore, we were able to calculate the procedure rate as the number of open RPs and MI-RPs reported in the NIS, weighted according to the NIS-stratified sampling scheme, divided by 20% of the total number of US men older than 45 years during the same time periods as previously described.⁸ Population estimates were obtained from the intercensal population estimates provided by the US Census Bureau.⁹

Differences in Patients Undergoing RP and Hospitals Between 2006 and 2011

To assess for differences between patients undergoing RP in 2006 and 2011, we compared age and race/ethnicity between open RP recipients and MI-RP recipients. We also studied variations over time in the number and caseload of the hospitals performing open RPs and MI-RPs between 2006 and 2011. These years were chosen to allow for sufficient numbers in the MI-RP group, because before 2006, the MI-RP group was substantially smaller than the open RP group.

Statistical Analyses

Negative binomial regression was used to study the trends in the annual and quarterly rates of open RP and MI-RP. The RP count was the dependent variable, and calendar-year quarter (first, second, third, or fourth) of hospital discharge was the independent variable, with the size of the population at risk for prostate cancer surgery as the offset term. Characteristics of patients undergoing open RP or MI-RP in 2006 were compared with those of patients undergoing such procedures in 2011 using the chi-square test, except for age, which was compared using the *t* test. Characteristics of hospitals providing open RPs or MI-RPs were compared using the chi-square test for categorical variables and the Wilcoxon rank sum test for differences in hospital caseloads. All statistical tests were 2-sided, with $P \leq .05$ indicating statistical significance. All calculations were performed using Stata version 12/MP (StataCorp LP).

RESULTS

Weighted estimates revealed that 962,917 men older than 45 years underwent RP at all nonfederally funded hospitals in the United States during the study period. The quarterly rate of total RPs in the United States remained

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