Variations Among Experienced Surgeons in Cancer Control After Open Radical Prostatectomy

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Purpose: Complications and functional outcomes after prostate surgery vary among surgeons to a greater extent than may be accounted for by chance. This excessive variation is known as heterogeneity. We explored whether there is also heterogeneity among high volume surgeons with respect to cancer control after surgery.

Materials and Methods: The study cohort consisted of 7,725 patients with clinically localized prostate cancer treated with open radical prostatectomy at 4 major American academic medical centers from 1987 to 2003 by 1 of 54 surgeons. We defined biochemical recurrence as serum prostate specific antigen 0.4 ng/ml or greater followed by a higher level. Multivariate random effects models were used to evaluate prostate cancer recurrence heterogeneity among surgeons after adjusting for case mix (prostate specific antigen, pathological stage and grade), surgery year and surgeon experience.

Results: We found statistically significant heterogeneity in the prostate cancer recurrence rate independent of surgeon experience ($p = 0.002$). Seven experienced surgeons had an adjusted 5-year prostate cancer recurrence rate of less than 10% while another 5 had a rate that exceeded 25%. Significant heterogeneity remained on sensitivity analysis adjusting for possible differences in followup, patient selection and stage migration.

Conclusions: Patient risk of recurrence may differ depending on which of 2 surgeons is seen even if the surgeons have similar experience levels. Surgical randomized trials are imperative to determine and characterize the roots of these variations.

Key Words: prostate, clinical competence, prostatic neoplasms, prostatectomy, neoplasm recurrence

Abbreviations and Acronyms

BCR = biochemical recurrence
EPE = extraprostatic extension
LNI = lymph node involvement
PSA = prostate specific antigen
RP = radical prostatectomy
SVI = seminal vesicle invasion

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RADICAL prostatectomy is a mainstay of treatment for localized prostate cancer. In a randomized clinical trial the procedure improved overall and cancer specific survival in men with intermediate to high risk prostate cancer.[1] Nonetheless, given the high degree of skill required for RP it is plausible that cancer control outcomes may vary among surgeons.

We distinguished 2 types of variation. The first one is associated with readily identifiable characteristics of a surgeon, such as yearly caseload (surgeon volume), total lifetime surgical experience and the number of cases treated at the hospital where the surgeon practices (hospital volume). Evidence of this type of variation is provided by studies showing an

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association between surgeon characteristics and patient outcomes.[2,3] The second type is related to unmeasured differences in approach (expected surgical plan) and technique (how a particular step in the operation is performed). These aspects of approach and technique associated with surgical success are often unknown and rarely documented adequately. Evidence that differences in approach and technique affect the outcome must be indirect. The degree of variation in outcome among surgeons is compared to the degree of variation expected by chance. If variation is higher than expected, heterogeneity is reported and unmeasured differences among surgeons may be responsible for the differences in observed results.

Several groups have investigated outcome heterogeneity among surgeons. In a RP study 8% of high volume surgeons showed a postoperative complication rate above the predicted 99th percentile and 3% had a rate below the 1st percentile.[4,5] This heterogeneity in morbidity outcomes was not explained by chance and suggests differences in surgical execution.

To our knowledge the possibility and the degree of heterogeneity in cancer control outcomes have not previously been investigated. This heterogeneity has particular relevance to patient care. For example, we reported that sufficiently experienced surgeons have an almost zero recurrence rate for organ confined prostate cancer.[6] Evidence for or against heterogeneity would be informative on whether this effect could be generalized to all surgeons with high experience or whether it was specific to the highly experienced surgeons in our data set. In this study we evaluated whether there is recurrence rate heterogeneity after RP. This is a good model in which to study heterogeneity because the outcome measure (BCR) is objective and well standardized. In our analysis we controlled for case mix, surgery year and surgeon experience. The question under study was whether patients can expect a similar outcome from surgeons with similar experience levels.

PATIENTS AND METHODS

Data Sources and Study Design

Our study cohort was described previously.[3] Briefly, 7,765 treatment naïve patients with prostate cancer underwent open retropubic RP between January 1987 and December 2003, as done by 1 of 72 surgeons at 1 of 4 participating institutions, including Memorial Sloan-Kettering Cancer Center, New York, New York; Baylor College of Medicine, Houston, Texas; Wayne State University Harper University Hospital, Detroit, Michigan; and Cleveland Clinic, Cleveland, Ohio. The first RP of a surgeon was defined as the initial case done after completing training in a urological residency program accredited by the Accreditation Council for Graduate Medical Education. For surgeons who pursued further training the first case was defined in terms of fellowship training completion. Surgeons whose RP experience began at a nonstudy institution were asked to provide the prior case load and those with fewer than 5 cases were excluded from analysis. All information was obtained with appropriate institutional review board waivers and data were de-identified before analysis.

Outcome Measure

Followup visits were in compliance with the standard of care clinical practice at each institutional clinic, consisting of serum PSA measurement every 3 to 4 months during postoperative year 1, semiannually in year 2 and annually thereafter. Digital rectal examination was done annually or when there was evidence of a PSA increase. For our outcome measure we defined prostate cancer recurrence as serum PSA greater than 0.4 ng/ml followed by higher PSA, ie BCR.[7] In rare cases, eg fewer than 1% in the Memorial Sloan-Kettering Cancer Center data set, secondary treatment was initiated in patients who did not meet the strict criteria for recurrence but had increasing PSA. Such treatment was counted as an event.

Statistical Methods

Our statistical methods followed those of our prior study of the learning curve.[3] Briefly, we created a multivariate, parametric, random effects regression, survival time model using a log-logistic survival distribution to model hazard with time. We adjusted for case mix by including PSA, stage, grade, surgery year and surgeon experience as model covariates. For each patient surgeon experience was coded as the number of RPs done by the surgeon before the patient operation and calculated directly from the data set. Since the relationship between surgeon experience and BCR is nonlinear, we used restricted cubic splines with knots at the quartiles. We did not cluster by institution because there is no plausible mechanism for how an institution could modify the BCR rate independent of a surgeon.

To test for heterogeneity among surgeons a random effect was included in the model for each surgeon to allow patients treated by that surgeon to be at higher or lower risk for subsequent recurrence. Random effects were assumed to follow an inverse Gaussian distribution and the variance of random effects was estimated to evaluate its departure from zero. A random effects variance significantly different from zero would suggest heterogeneity among surgeons that could not be explained by model covariates.

Our overall objective was to determine whether oncological outcome varies among surgeons due to differences in surgical technique. Thus, we did not include margin status in our initial model because margins depend on technique.[8,9] A surgeon with poor technique may show a higher positive margin rate and more recurrences. Controlling away the difference in margin rates may lead to a false conclusion of no difference in recurrence. To determine whether differences in technique could affect outcome beyond achieving clear margins we performed additional analysis including surgical margin status as a covariate in the multivariate model. Statistical analysis was done with Stata® 9.2.