Open Conversion during Minimally Invasive Radical Prostatectomy: Impact on Perioperative Complications and Predictors from National Data

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Purpose: Despite the increased use of minimally invasive radical prostatectomy, open conversion may occur due to surgical complications, surgeon inexperience or failure to progress. We used nationally representative data to quantify the impact of open conversion compared to nonconverted minimally invasive radical prostatectomy and open radical prostatectomy, and identify predictors of open conversion.

Materials and Methods: Years 2004 to 2010 of the Nationwide Inpatient Sample were queried for patients who underwent radical prostatectomy to analyze the association of open conversion during minimally invasive radical prostatectomy with Clavien complications. Multivariate regression models yielded significant predictors of open conversion.

Results: From 2004 to 2010, 134,398 (95% CI 111,509–157,287) minimally invasive radical prostatectomies were performed with a 1.8% (95% CI 1.4–2.1) open conversion rate, translating to 2,360 (95% CI 2,001–2,720) conversions. Open conversion cases had a longer length of stay (4.17 vs 1.71 days, $p < 0.001$) and higher hospital charges ($51,049 vs $37,418, $p < 0.001$) than nonconverted cases. Of open conversion cases 45.2% experienced a complication vs 7.2% and 12.9% of minimally invasive radical prostatectomy and open radical prostatectomy cases, respectively ($p < 0.001$). After adjusting for age and comorbidities, open conversion was associated with significantly increased odds of a Clavien grade 1, 2, 3 and 4 complication compared to nonconverted minimally invasive radical prostatectomy and open radical prostatectomy (OR range 2.913 to 15.670, $p < 0.001$). Significant multivariate predictors of open conversion were obesity (OR 1.916), adhesions (OR 3.060), anemia (OR 5.692) and surgeon volume for minimally invasive radical prostatectomy less than 25 cases per year (OR 7.376) (all $p < 0.01$).

Conclusions: Open conversion during minimally invasive radical prostatectomy is associated with a higher than expected increase in complications compared to open radical prostatectomy and minimally invasive radical prostatectomy after adjusting for age and comorbidities. External validation of predictors of open conversion may prove useful in minimizing open conversion during minimally invasive radical prostatectomy.

Key Words: prostatic neoplasms, prostatectomy, robotics, conversion to open surgery, complications

Abbreviations and Acronyms

MIRP = minimally invasive radical prostatectomy

NIS = Nationwide Inpatient Sample

OC = open conversion

ORP = open radical prostatectomy

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THE incidence of minimally invasive radical prostatectomy has increased compared to open radical prostatectomy with claims of lower complication rates. A report of Medicare data showed that ORP was associated with

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increased 30-day mortality and perioperative complications compared to MIRP.[1] Further studies from the Nationwide Inpatient Sample,[2] NSQIP (National Surgical Quality Improvement Program)[3] and the Premier Perspective Database[4] demonstrated decreased intraoperative and postoperative complications, length of stay and 30-day hospital readmission with MIRP vs ORP. A recent analysis of the Health Professionals Follow-up Study reported that MIRP and ORP had equivalent surgical, oncologic and quality of life outcomes.[5] These reports were reaffirmed by systematic reviews describing lower rates of blood transfusion,[6] impotence[7] and incontinence[8] with MIRP compared to ORP in the context of equivalent surgical margin rates and biochemical recurrence rates.[9] A recent systematic review even supported the use of MIRP in cases of high risk prostate cancer.[10] Thus, MIRP appears to be safe and oncologically equivalent to ORP with potentially fewer perioperative surgical complications.

Nevertheless, surgical procedures that begin as MIRP but are converted to ORP remain under studied in the urological literature. Several single institution series have attempted to describe the clinical parameters and impact of conversion. The incidence of OC varies from 0.08% to 5% but may be as high as 19% during the early part of a surgeon's learning curve.[11–14] In the first national analysis of OC rates in 2008 Hu et al used insurance claims data to show that OC rates decreased from 28.6% in 2003 to 4.5% in 2005.[15] However, the analysis did not go beyond 2005, at which point robotic prostatectomy was still a developing technique. Given that OC is not uncommon, it is critical to understand its impact on patient outcomes and to identify patients who may be at risk for such an event.

We suspect that the incidence of OC has further decreased as the technique of MIRP has matured. However, we also suspect that OC has significant consequences for patients as the number of surgeons proficient in ORP has decreased during the last decade. To address these hypotheses we used the years 2004 to 2010 of the Nationwide Inpatient Sample to study complication rates of patients who underwent OC after adjusting for patient age and comorbidities. We also identified patient and surgeon factors that would increase the likelihood of OC.

MATERIALS AND METHODS

Data Set Description

Years 2004 to 2010 of the Nationwide Inpatient Sample were queried for patients who underwent radical prostatectomy to perform a retrospective, cross-sectional study of OC after MIRP. Institutional review board approval was not required by our institution to analyze public data sets preapproved by government agencies. The NIS is the largest inpatient database in the United States, encompassing more than 8 million discharges from more than 1,000 hospitals across the country. This sample accounts for approximately 20% of all hospital admissions in the United States and is extrapolated based on predefined discharge weights to create national estimates of cross-sectional data. More than 100 data elements are collected for every patient, including patient demographics, comorbidities, hospital characteristics, length of stay and total hospital charges.

Diagnoses and procedures are codified in the NIS using ICD-9-CM diagnosis and procedure codes. Surgeon volume was obtained using surgeon identification codes. However, these codes were not available for 2010, so all analyses with surgeon volume were limited to 2004 to 2009. Additionally, surgeon volume data could not be extracted for every hospital admission from 2004 to 2009 as several states introduced surgeon identification numbers at various years during the study period. Further description of the NIS methodology is available from the Agency for Healthcare Research & Quality.[16]

Study Design

Supplementary table 1 (http://jurology.com/) lists the ICD-9-CM codes used in this study. Study inclusion criteria for MIRP consisted of the code for radical prostatectomy (60.5) in conjunction with the code for laparoscopy (54.21) or robotic assistance (17.42) to identify MIRP. If the code for OC (V64.4 or V64.41) appeared during the same admission as the code for radical prostatectomy, the patient was considered to have undergone OC. Since the majority of OC cases were coded as ORP + OC, the original minimally invasive approach could not be obtained, precluding any distinction between laparoscopic and robotic MIRP in our analysis. Patients who underwent radical prostatectomy without modifier codes for laparoscopy, robotic assistance or OC were designated as the ORP cohort. All patients satisfying the criteria for MIRP, OC-MIRP or ORP were included in the analysis.

Outcomes and Statistical Analysis

The primary outcome involved comparison of complication rates across OC, MIRP and ORP using the Clavien classification system, a method used in other ICD-9-CM based studies.[17,18] Multivariate regression modeling was used to compare rates of each complication across the 3 groups after adjusting for age and comorbidities. The Elixhauser method was chosen to adjust for patient comorbidities[19] as it is incorporated into the NIS and performs favorably compared to other indices.[20] Total charges and length of stay were also analyzed.

The second aim of the study was to identify factors predicting OC. Univariate logistic regressions were run for several patient, hospital and surgeon factors to determine their impact on OC. Factors that were significant on univariate analysis ($p < 0.05$) were entered into a multivariate logistic regression model to predict OC. Only factors significant at the $p < 0.20$ level were retained in the final multivariate model. Comorbid fluid and electrolyte disorders were not included in the model because ICD-9-CM codes did not specify if the conditions were