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Changing Practice Locations for Upper Urinary Tract Stone Disease

Seth A. Strobe, J. Stuart Wolf Jr., Gary J. Faerber, William W. Roberts, and Brent K. Hollenbeck

Department of Urology, University of Michigan

Abstract

Objectives—Complex surgical procedures are migrating out of hospitals and into ambulatory surgery centers. We evaluated the extent to which surgery for urolithiasis could be a candidate for such migration.

Methods—Patients undergoing stone surgery in Florida (n=107,417) between 1998 and 2004 were included. Poisson models were fit to assess temporal changes in the setting (inpatient, outpatient, and ambulatory surgery center), and type (open, percutaneous, extracorporeal, ureteroscopy, and stenting) of stone surgery. For inpatient procedures, secular trends in comorbidity burden (0 or 1 diagnoses vs. 2 or more) and procedure acuity (elective versus emergent) were also assessed. Admission requirements and mortality rates were measured according to the setting of surgery.

Results—In the 107,417 discharges from 1998 to 2004, surgery rates per 100,000 increased from 35.5 to 38.2 for inpatients ($p < 0.05$), 84.2 to 104.7 for hospital outpatients ($p < 0.01$), and 9.4 to 26.9 for ambulatory surgery centers ($p < 0.01$). In hospitalized patients, routine admissions decreased (41.8% to 29.5%; $p < 0.01$), and procedure acuity increased (16.8% to 28.2%; $p < 0.01$). No deaths occurred in ambulatory surgery centers, and the rate of admission to acute care hospitals was 2.5 per 100,000 cases.

Conclusions—Despite the safety and efficiency of ambulatory surgery centers, hospital outpatient departments remain the preferred setting for urinary stone surgery. For patients requiring surgical intervention for urinary stone disease, ambulatory surgery centers could be an underused resource.

Introduction

Complex surgical procedures are migrating out of hospitals and into ambulatory surgery centers.¹ Recent changes in the Medicare program are designed to further accelerate this trend by increasing the reimbursement for many of the procedures performed in these freestanding facilities.² However, most if not all of the increases are for procedures that are currently uncommonly performed in ambulatory surgery centers (ASCs). Coincident with this change, facility reimbursements for lower complexity procedures, such as cystoscopy, are scheduled to decline. Prior to the implementation of the new payment structure for ASCs in 2008, facilities providing primarily urological services relied on less complex procedures for operating revenue. Thus, urological ambulatory surgery centers will need to provide services of increasing complexity to survive and grow under the new fee system.³ Ideal

candidates for migration from the hospital outpatient department to the ambulatory surgery center would need to be common, safe, and have low admission requirements.

While upper urinary tract stone procedures are common, the extent to which they meet the criteria is unclear. Many of these cases, such as ureteroscopy and shock wave lithotripsy, are already performed almost exclusively on an outpatient basis.⁴ Furthermore, utilization of ambulatory surgical centers increased substantially in the 1990s.⁵ Migration to freestanding facilities has inherent advantages, including greater physician efficiency⁶ and lower copayments for patients.¹ However, potential barriers to the movement of these procedures into non-hospital environments exist. Ambulatory surgery centers need to be equipped to handle these procedures; requiring capital investment and new technical resources at the facility. Even if the investment issue is overcome, patient factors may preclude adequate migration. For example, approximately 7% of patients experience significant complications after ureteroscopy or shock wave lithotripsy.⁷ However, admission requirements after stone surgery are unclear. With such data lacking, migration of stone surgery to freestanding facilities is unlikely.

For this reason, we undertook a study to understand issues surrounding use of ambulatory surgery centers for urinary stone surgery. Using population-based data from Florida, we explore secular trends in stone surgery, including the potential reservoir of patients available for migration from the hospital outpatient department to the ambulatory surgery center. Finally, we delineate the extent to which barriers to migration (e.g., mortality and admission requirements) might preclude movement.

Materials and Methods

Study Cohort

We identified patients from the Florida State Ambulatory Surgery Database (SASD) and State Inpatient Database (SID) who underwent surgery for stone disease in 1998, 2000, 2002, and 2004. The SASD and SID are compendiums of datasets from 24 state Data Organizations administered by the Federal Agency for Healthcare Research and Quality as part of the Healthcare Cost and Utilization Project. These data provide patient level discharge data for 100% of the patients from facilities in the participating states.⁸ Data from Florida provided many advantages for this study. Since Florida tracks discharges from ambulatory surgery centers in addition to hospital outpatient departments in the SASD, complete outpatient data could be obtained. Further, Florida does not subject medical facilities to certificate of need requirements,⁹ allowing physicians and investors to respond to changing market demands for health care. Finally, all non-federal short stay hospitals are included in the Florida SID; providing a broad sample of inpatient procedure use.

We defined a cohort of patients with admissions for stone disease using the following ICD-9 Diagnosis Codes: 788.0 (acute renal colic), 592.0 (renal calculus), 592.1 (calculus of ureter), or 592.9 (unspecified calculus of kidney and ureter). The cohort was limited to patients who underwent surgery using the CPT and ICD-9 procedure codes from the SASD and SID listed in the appendix. Our final cohort consisted of 107,417 discharges. Procedures were then classified by the setting in which they were performed (hospital inpatient, hospital outpatient, ambulatory surgery center). Information on age, gender, insurance status, and race for each discharge was obtained directly from the SASD and SID, and is stratified by practice setting in Table 1.

Outcomes

For all outcomes, the discharge was the unit of analysis. Annual counts of procedures were measured at the patient level, and population-based rates of surgery were determined using

inter-censal population counts from the US census bureau. Then to control for changes in gender and age distributions across the years of the study, all rates were standardized by age and gender to the U.S. population for the year 2000. For inpatient procedures, secular trends in comorbidity burden (0 or 1 diagnoses vs. 2 or more) and procedure acuity (elective versus emergent) were also assessed. Acuity of the admission (elective versus emergent) was assessed through the admission source variable available in the data. All routine admissions were considered elective, and all other admissions (emergency room admissions and transfers from other health care facilities) were considered emergent. Comorbidity was measured using secondary diagnosis codes using the methodology described by Elixhauser and colleagues.¹⁰ Between hospital transfers for inpatients, admissions for outpatients, and mortality for all settings were assessed for 2004, the year in which the data was available.

Statistical Analysis

Secular trends in rates of stone surgery within each setting were compared using multiple Poisson regression. Models were adjusted for patient age (0–19, 20–39, 40–59, 60–79, 80+) and gender. Rates of change between settings were compared using an interaction term between the year of the procedure and the location using inpatient surgery as the reference location. The significance of the interactions, representing a difference in rates between settings, was assessed using Wald chi-square tests, correcting for multiple comparisons. Next, secular relationships in procedure acuity, comorbidity burden and need for hospitalization were next assessed using the Cochran-Armitage test for trend. Factors impacting inpatient surgery admissions over time were then measured.

Finally, overall surgery rates were stratified according to procedure (open surgery, percutaneous surgery, shock wave lithotripsy, ureteroscopy, and cystoscopy). Trends in utilization were measured separately for each procedure through multiple Poisson regression models. Models were adjusted for patient age (0–19, 20–39, 40–59, 60–79, 80+) and gender. Overall utilization was assessed, followed by use of inpatient, hospital outpatient, and ambulatory surgery center environments. Changes in utilization of the three environments were assessed stratified by procedure. Models, including interaction terms between year and setting of surgery, were fit using the inpatient setting as the reference category. The Wald chi-square test was used to ascertain the significance of the interaction term, which represented differences in the rate of change in utilization according to setting.

All testing was conducted using SAS Version 9.1.2 (SAS Institute, Cary, NC) using two-sided tests. The probability of Type 1 error was set at 0.05. This study, dealing with publicly available data was exempt from institutional review board approval in accordance with the Code of Federal Regulations, Title 45, Section 46.101.

Results

Stone surgery in all practice environments increased over the six years of the study (Figure 1). From 1998 to 2004, inpatient surgery for stone disease increased from 35.5 to 38.2 procedures per 100,000 ($p = 0.05$). Use of the hospital outpatient department and ambulatory surgery center for stone surgery also increased, from 84.2 to 104.7 and 9.4 to 26.9 procedures per 100,000 (both $p < 0.01$ for trend) respectively. Growth in the hospital outpatient department and ambulatory surgery center outpaced that of the inpatient utilization ($p < 0.01$ for each comparison to the inpatient setting).

The percentage of patients with two or more comorbidities treated in the hospital environment grew from 16.8% in 1998 to 28.2% in 2004 (Figure 2; Z statistic -12.66 $p < 0.01$). In contrast, routine admissions decreased from 41.8% of all hospital cases in 1998 to 29.5% of the cases in 2004 (Figure 3; Z statistic 16.6 $p < 0.01$). Using data from 2004, we

next assessed the safety and admission requirements for stone surgery. Thirty-three patients were transferred from the institution where their stone surgery was performed to another short stay hospital (rate 1.1 per 100,000 treated patients). Of these, 13 were transferred from one inpatient hospital to another (rate 1.9 per 100,000 inpatient procedures), 8 were transferred from a hospital outpatient department to another hospital (rate 0.4 per 100,000 hospital outpatient procedures), and 12 were transferred from an ambulatory surgery center to a short stay hospital (rate 2.5 per 100,000 ambulatory surgery center procedures). There were no deaths recorded in either hospital outpatient departments or ambulatory surgery centers. Overall nine patients died after having surgery related to urinary stone disease (rate 1.3 per 100,000 inpatient procedures).

Stratification by procedure reveals changes in use of stone surgery across the practice environments (Figure 4). Rates of open surgery decreased (Figure 4a), and rates of other procedures increased (Figures 4b-e). Among the procedures with increasing utilization, use of outpatient settings grew significantly, with the exception of percutaneous surgery (Figure 4b: $p = 0.44$ for change in outpatient rate). While the use of hospital outpatient and ambulatory surgery center settings increased for shock wave lithotripsy (Figure 4c: $p < 0.01$ for both), neither increase was significantly faster than that of the inpatient setting ($p = 0.96$ hospital outpatient; $p = 0.08$ ambulatory surgery center). In contrast, utilization of ambulatory surgery centers increased faster than inpatient settings for both ureteroscopy (Figure 4d; $p < 0.01$) and cystoscopic procedures (Figure 4e; $p = 0.03$).

Discussion

Standardized rates of urinary stone surgery increased from 1998 to 2004. These surgeries are increasingly being performed in outpatient settings. Much of the shift to outpatient surgery stems from increased use of both shock wave lithotripsy and ureteroscopy. Not surprisingly, these population-based data support the safety of outpatient stone surgery and underscores that unplanned hospital admission are relatively uncommon. However, despite these findings, the hospital outpatient department continues to be the preferred setting for stone surgery with rates nearly four times those of the ambulatory surgery center.

As stone surgery increasingly shifts to the outpatient settings, physicians must determine the most efficient location in which to provide care. Concurrent with this migration, payers will exert financial pressures on physician-owned facilities to move more complex procedures out of the hospital departments. Compared to hospitals, ambulatory surgery centers provide lower average expenses for surgery.² At the system level, an estimated \$1 billion dollars in added Medicare expenditures resulted from performance of procedures in hospital outpatient departments instead of ambulatory surgery centers.¹¹ As a result, ambulatory surgery centers, within the current financial model, have a major role to play in lowering the expenditures related to outpatient surgery in the United States. This cost containment function is especially necessary for urinary stone surgery where utilization of services has been increasing.

Despite the cost advantages of ambulatory surgery centers over hospitals for delivery of outpatient care, potential barriers exist for expansion of stone surgery in these centers. First, since these facilities are freestanding (i.e., without attached hospital), they tend to necessarily treat healthier patients than hospitals.¹² Expansion of the patient base for stone surgery in ambulatory surgery centers may necessitate inclusion of patients with increased risk of peri-operative or post-operative complications, including admission to acute care hospitals. However, these data confirm that admission, whether following a procedure at an ambulatory surgery center or hospital outpatient department, is an uncommon phenomenon after stone surgery. Second, facilities need to be equipped to handle these cases. In the case

of shock wave lithotripsy, the ambulatory surgery center needs access to a lithotripter. For ureteroscopy, the facility needs fluoroscopic capability, holmium laser, endoscopes, and disposable equipment. Although these resources may be available in many facilities, we previously found that such complex procedures are rarely performed in ambulatory surgery centers specializing in urologic procedures.³ Third, at the societal level, physician ownership of ambulatory surgery centers may lead to lowering of thresholds for surgical intervention, as has been seen in other medical fields.^{13–16} Patients with small stones likely to pass spontaneously may be more likely to receive surgical intervention when the treating facility is owned by the doctors working there. Finally, increased use of ambulatory surgery centers for urinary stone surgery will not decrease inpatient costs. Importantly, these patients are getting sicker and are more likely to require emergent procedures. Clearly, this relatively small patient population will not be candidates for migration to ambulatory surgery centers.

This study does have some important limitations to consider. First, since data was available at the discharge level, and not explicitly at the patient level, we were not able to assess the number of patients who were treated in one environment and then retreated in another. As an example, patients treated with shock wave lithotripsy as outpatients may be readmitted for steinstrasse and have percutaneous nephrostomy tubes placed as an inpatient. Such scenarios would be important to track if total complication rates were sought. However, we desired to define how many acute complications occurred in ambulatory surgery center and hospital outpatient settings, and the data set provides this level of detail. Second, we did not have clinical data (e.g., stone size and location) available that might also effect the decision of where to treat the patient. Lastly, certain features of the Florida health care market (lack of certificate of need requirements and higher overall use of services compared to other states) may make the results of this study less applicable to other states. For example, migration of care into ambulatory surgery centers may be even less frequent in states with certificate of need requirements. However, the finding that stone surgery appears to be safely delivered outside the hospital setting is not dependent on the factors unique to the Florida market.

Conclusions

Rates of urinary stone surgery increased between 1998 and 2004 in all surgical settings. Surgical procedures for upper tract urinary stone disease continue to shift to less invasive forms of therapy. Care was safely delivered outside of the hospital with low rates of patient transfer to acute hospital settings and low mortality. Despite this, the hospital outpatient department is by far and away the preferred setting for the surgical management of urinary stones. For patients requiring surgical intervention for urinary stone disease, ambulatory surgery centers could be an underused resource.

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Figure 1. Rates of Inpatient, Hospital Outpatient, and Ambulatory Surgery Center Use by Year
The growth of inpatient, hospital outpatient, and ambulatory surgery center use were all significant ($p = 0.0464$, $p < 0.0001$, $p < 0.0001$ respectively). Hospital outpatient department and ambulatory surgery center growth rates were significantly steeper than inpatient growth ($p < 0.01$ hospital outpatient; $0 < 0.01$ ambulatory surgery center).

Figure 2. Proportion of Inpatient Cases with Comorbidity by Year

The percentage of patients with two or more comorbidities treated in the hospital environment grew from 16.8% in 1998 to 28.2% in 2004 (Figure Z statistic -12.66 $p < 0.01$).

Figure 3. Proportion of Inpatient Cases Performed after Elective or Emergent Admission
Routine admissions decreased from 41.8% of all hospital cases in 1998 to 29.5% of the cases in 2004 (Z statistic 16.6 $p < 0.01$).

Figure 4. Changes in Location of Procedures by Procedure Type

Significant changes in use of surgical procedures were found for shock wave lithotripsy (39.2 to 67 per 100,000 1998 to 2004; $p < 0.01$), and ureteroscopy (Figure 2d; 41.8 to 52.2 per 100,000 1998 to 2004; $p < 0.01$). Rates of shock wave lithotripsy increased significantly in the hospital outpatient and ambulatory surgery center environments ($p = < 0.01$, $p = < 0.01$ respectively). Hospital outpatient and ambulatory surgery center utilization of ureteroscopy also increased significantly ($p = 0.01$ and $p < 0.01$ respectively). Increased use of percutaneous surgery from 5.5 to 6.7 per 100,000 from 1998 to 2004 approached, but did not reach statistical significance ($p = 0.07$).

Table 1

Characteristics of discharged patients across care settings

	No. Inpatient (%)	No. Hospital Outpatient (%)	No. ASC (%)	Totals *
Age group:				
0–19	623 (34)	1,060 (57)	163 (9)	1,846 (2)
20–39	6,347 (27)	14,099 (60)	2,898 (13)	23,344 (22)
40–59	9,906 (22)	27,876 (62)	6,927 (16)	44,709 (41)
60–79	7,265 (22)	21,788 (66)	4,064 (12)	33,117 (31)
80 +	1,261 (29)	2,732 (62)	408 (9)	4,401 (4)
Race:				
White	18,964 (22)	54,610 (64)	12,044 (14)	85,618 (80)
Not white	6,438 (30)	12,945 (59)	2,416 (11)	21,799 (20)
Gender:				
M	14,775 (22)	42,112 (64)	9,252 (14)	66,139 (62)
F	10,625 (26)	25,443 (62)	5,204 (12)	41,272 (38)
Payer:				
Medicare	6,892 (24)	18,839 (67)	2,551 (9)	28,282 (26)
Medicaid	1,813 (37)	2,938 (59)	198 (4)	4,949 (5)
Private	13,228 (20)	40,362 (63)	10,789 (17)	64,379 (60)
Self-pay	1,919 (44)	2,071 (47)	372 (9)	4,362 (4)
No charge	744 (39)	1,153 (60)	30 (1)	1,927 (2)
Other	806 (23)	2,192 (62)	520 (15)	3,518 (3)

* Percentages total to 100% for each variable.