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Changes in Gender Distribution of Urinary Stone Disease

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Abstract

Introduction and Objectives—Historically, stone disease has been more common among men than women. However, differential changes in dietary intake patterns, fluid intake, and obesity in men and women may cause shifts in stone disease incidence and prevalence. Thus, using population-based data we explore the extent to which gender specific rates of stone disease are changing.

Methods—The State Ambulatory Surgical Database and the State Inpatient Database were queried for procedures related to renal colic or urolithiasis. Population-based rates of utilization were calculated for the years 1998 to 2004 by gender. Poisson regression models were fit to measure changes in utilization rates over time.

Results—Of the 107,411 discharges for stone disease, 41,272 (38%) occurred in women. Service utilization increased in both men and women (86.6 to 105.5 and 42.5 to 64.4 per 100,000; $p < 0.01$ in both). However, the growth rate in women outpaced men ($p < 0.01$). Rates of outpatient (57.2 to 65.8 and 27.0 to 38.9 per 100,000; $p < 0.01$) and ambulatory surgery center use (6.4 to 17.7 and 2.9 to 9.3 per 100,000 men and women; $p < 0.01$) increased significantly in men and women, but inpatient utilization only increased in women (12.5 to 16.3 per 100,000; $p < 0.01$).

Conclusions—Resource utilization for stone disease continues to rise. The majority of this increase appears to be due to an increase in disease among women. Increasing obesity, dietary changes, or decreased fluid intake may be contributing to the rapid increase in stone disease treatments in women.

Keywords

nephrolithiasis; epidemiology; surgery; female

Introduction

Upper urinary tract stone disease occurs more commonly in men than in women. Early epidemiological studies placed the incidence rate of stone disease in men at 2.2 to 3.4 times that of women.¹ However, recent evidence suggests these gender ratios may be changing. Updates of the original epidemiologic studies suggest the incidence rate ratio has narrowed

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to 1.3.² Other reports using national databases of hospital admissions³ and outpatient care⁴ have found similar results. Furthermore, patient self reports suggest an increasing burden of stone disease among women.⁵

Although these recent studies suggest changes in gender distribution of stone disease, these studies have not been definitive. Through an examination of resource utilization in various practice settings, a more complete picture of the current gender distribution of stone disease is obtained. These changes in resource utilization, while not directly revealing incidence and prevalence, are indirectly related to these measures. Furthermore, changes in incidence and prevalence of stone disease reflect changes in underlying risk factors for disease. By identifying changing patterns of disease, new avenues in prevention may be elucidated. Additionally, accurate knowledge of stone disease epidemiology allows clinicians to better assess patients with acute abdominal pain and tailor care appropriately.

In an effort to further elucidate the possible changes in gender distribution of urinary stone disease, we undertook a study of the use of medical resources in Florida. Specifically we studied changes in utilization of inpatient, hospital outpatient, and ambulatory surgery center services for urinary stone disease. Through examination of this total health care utilization, we provide further evidence for changes in upper urinary tract stone disease gender distribution.

Methods

Study Cohort

We identified subjects 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, and they provide patient level discharge data for 100% of the patients from facilities in the participating states.⁶ These datasets include information extracted from billing data at the time of the hospital or ambulatory surgical center discharge. Available fields include patient age, gender, race, procedure codes, and diagnosis codes. For privacy considerations, no patient identifiers are available in the dataset. Thus, individual patients cannot be tracked over time. Data from Florida provided many advantages for this study, including full ascertainment of cases from ambulatory surgical centers and inclusion of all non-federal short stay hospitals.

We defined a cohort of patients discharged from hospitals and ambulatory surgical centers with the following International Classification of Disease (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 Common Procedural Terminology (CPT) and ICD-9 procedure codes from the SASD and SID as listed in the appendix. The final cohort included 107,411 discharges for stone disease in the years examined; 66,139 in men and 41,272 in women.

Outcome Measurements

Using the patient discharge as the primary unit of analysis, we calculated the rates of treatment for stone disease in men and women by year. Annual counts of procedures were measured at the discharge level, and population-based rates of therapy were determined using inter-censal population counts from the US Census Bureau. 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. We then examined the rates of therapy

stratified by location of service: inpatient, hospital outpatient, and ambulatory surgery center.

Statistical Analysis

Secular trends in rates of stone treatment by gender 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 for men and women were compared using an interaction term between the year of the procedure and gender. The significance of the interactions, representing a difference in rates between genders, was assessed using Wald chi-square tests.

Next, the gender specific utilization rates were stratified by location of service: inpatient, hospital outpatient, and ambulatory surgery center. Trends in utilization were measured separately for each location through multiple Poisson regression models. Models were adjusted for patient age (0–19, 20–39, 40–59, 60–79, 80+) and gender. To test for changes in the rate of utilization by gender, we included interaction terms between year and gender in the models. The Wald chi-square test was used to ascertain the significance of the interaction term.

Results

Overall procedures for urolithiasis increased significantly between 1998 and 2004. Total discharges related to urinary stone disease increased from 129.1 to 169.9 per 100,000 ($p < 0.01$). Utilization among men increased from 86.6 to 105.5 per 100,000 (Figure 1; 22% increase), while utilization by women increased from 42.5 to 64.4 per 100,000 (Figure 1; 52% increase). Although procedure use in both genders increased ($p < 0.01$ for both groups), the rate of growth in women was significantly greater than in men ($p < 0.01$). The ratio of men to women discharged after urinary stone surgery decreased from 2 in 1998 to 1.6 in 2004.

Utilization of inpatient services was relatively flat between 1998 and 2004. Overall admissions increased from 35.5 per 100,000 to 38.3 per 100,000 (Figure 2; 8% increase, $p = 0.05$). This small increase in inpatient services was attributable solely to utilization by female patients. Inpatient admissions in women increased from 12.5 to 16.3 per 100,000 (30% increase, $p < 0.01$), but no increase was observed in men (23.0 to 22.0 per 100,000; $p = 0.7964$). Utilization increased significantly faster in women than in men ($p = 0.01$). The ratio of men to women treated in the inpatient setting decreased from 1.8 in 1998 to 1.3 in 2004. Between these two time periods, the distribution of patients receiving a definitive therapy (i.e. ESWL, percutaneous nephrolithotomy, ureteroscopy) was stable in men and women. In 1998, 53% of men received definitive therapy compared to 53% in 2004. In women, the percentage of patients who received definitive therapy remained at 49% in both 1998 and 2004.

Hospital outpatient department utilization increased 24.3% between 1998 and 2004 from 84.2 to 104.7 per 100,000 (Figure 3). While the use of the hospital outpatient department increased both among women (27.0 to 38.9, 44% increase; $p < 0.01$) and men (57.2 to 65.8, 15% increase; $p = 0.01$), the rate of increase was faster in women ($p < 0.01$). The ratio of men to women treated in the hospital outpatient department decreased from 2.1 in 1998 to 1.69 in 2004.

Ambulatory surgery center utilization increased rapidly from 1998 to 2000, but then stabilized (Figure 4). Significant growth of this surgical environment occurred in both men (6.4 to 17.7 per 100,000, 176% increase; $p < 0.01$) and women (2.9 to 9.3 per 100,000,

202% increase; $p < 0.01$ for both), and no difference existed for growth in ASC use comparing the two groups ($p = 0.44$). The ratio of men to women for ASC use in stone disease treatment was 2.2 in 1998 and 1.9 in 2004.

No changes were seen in the study period in the mean age, or age distributions, of the discharges treated for stone disease. The mean age in the cohort was 52 at the time of discharge. The mean age of the men in the cohort was 54, and for women it was 50. These mean ages did not vary between 1998 and 2004. The age distribution of women also did not change during the study period. In 1998, 36% of the surgeries were in women aged 40 to 60. By 2004, 40% of the surgeries were in this age group. In 1998, 31% of surgeries for stone disease were in patients younger than 40 years of age. By 2004, this population represented 29% of the total cohort of women treated surgically for stone disease.

Discussion

Resource utilization increased for stone disease in both men and women. However, growth was significantly faster in women than in men. Utilization of outpatient surgical settings grew for both men and women, but only women showed an increase in inpatient hospitalizations. These results suggest treatment of stone disease is increasing in both genders and that nephrolithiasis is becoming more common in women.

This study supports recent findings of changing gender distributions of upper urinary tract stone disease. In data from a population based study in Rochester Minnesota, the male to female ratio of stone disease incidence decreased from 3.1 to 1.3 between 1970 and 2000.² Consistent with our findings regarding inpatient utilization, incidence rates of urolithiasis increased in women and decreased in men in the Rochester data. Echoing these findings, a study based on the Nationwide Inpatient Sample found that between 1997 and 2002 the ratio of prevalent stone disease between men and women decreased from 1.7 to 1.3.³ Consistent with these results, we found the ratio of men to women treated in inpatient settings decreased from 1.8 to 1.3. Since inpatient hospital care is largely reserved for emergent care of incident stones or the treatment of larger stones, the increased use of inpatient services among women suggests that the gender distribution of significant stone disease is approaching parity between men and women. Overall prevalence of stone disease may still be higher in men, as seen in the smaller decreases in the gender ratios within outpatient settings.

Changing gender ratios for stone disease may result from a variety of etiologies. Obesity is associated with increased prevalence of nephrolithiasis⁷ and increased risk of kidney stone formation.⁸ During the time frame of our study, the prevalence of obesity increased in both men and women,⁹ but morbid obesity is more common in women than in men.¹⁰ Given the higher risk of stone formation in obese women compared to men,⁸ the obesity epidemic in the United States could be an etiology behind shifting gender ratios. Dietary changes may also play a role in the etiology of stone formation. Increased risk of nephrolithiasis is associated with high animal protein diets, high salt diets, and low calcium diets.¹¹ While these dietary patterns were previously more commonly associated with men than women in the past,¹² the popularity of high protein low carbohydrate diets during our study period may have contributed to the observed changes in gender ratios. Finally, decreased fluid intake is associated with stone disease.¹³ Changing work environments or fluid intake patterns for men and women may also contribute to the changes in gender ratios for stone disease.

The findings from this study should be interpreted with some considerations in mind. This population for this study came from the state of Florida. As such, the changes in gender ratios may not be representative of the United States as a whole. However, our findings are

consistent with other data supporting changing gender ratios of stone disease. As discharge level databases, the SASD and SID do not allow for tracking individual patients over time. Thus, some patients may be represented multiple times in the cohort. Such occurrences do not change the overall finding of the increased resource use for women, as this limitation would be the same in all years of the data. Further, because this study used administrative data we do not have access to patient characteristics such as dietary and environmental factors, or stone composition, which might explain the changing gender ratios for stone disease. Thus, defining the underlying etiology responsible for changing gender prevalence of stone disease requires more detailed data. Finally, by measuring resource utilization, we approach the issues of incidence and prevalence of stone disease indirectly. If there has been no change in the aggressiveness of surgical intervention for stone disease over the time period studied, then overall resource utilization serves as an effective proxy for prevalence, and inpatient procedure utilization serves as an effective proxy for incidence of stone disease. However, differential secular trends between men and women in the intensity at which stone disease is treated could cause the narrowing of gender ratios for stone disease without an underlying change in incidence or prevalence in stone disease by gender. Our results examining inpatient procedural use do not provide evidence for increasing intensity of therapy in women compared to men, making the increased utilization more likely a result of increasing stone incidence in women.

Conclusions

Resource utilization for urinary stone disease rose 22% for men and 52% for women, reflecting an increasing resource use in women compared to men. These findings support the contention that the prevalence of stone disease is increasing in women. Importantly, inpatient admissions did not increase in men, but grew by 23% in women, resulting in an 8% increase in overall utilization. This increased use of inpatient resources in women suggests the incidence of stone disease among women may be increasing. While the underlying etiology of this changing gender ratio of stone disease cannot be elucidated from this study, increasing obesity, dietary changes, or changing fluid intake patterns may all contribute to the rapid increases in stone disease seen in women.

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Figure 1. Overall Admissions for Upper Urinary Tract Stone Disease

Admissions for urinary stone disease increased from 129.1 to 169.9 per 100,000 over the six years of the study ($p < 0.01$). Both men and women increased utilization ($p < 0.01$ for both groups). However, the rate of growth in women was greater than in men ($p < 0.01$).

Figure 2. Inpatient Admissions for Upper Urinary Tract Stone Disease

Inpatient admissions in women increased ($p < 0.01$). No increase was found in men ($p = 0.7964$). The increase in women was significantly greater than in men ($p = 0.01$).

Figure 3. Hospital Outpatient Department Utilization for Upper Urinary Tract Stone Disease Outpatient admissions in both women and men grew significantly ($p < 0.01$ women and $p = 0.01$ men). Utilization grew faster in women compared to men. ($p < 0.01$).

Figure 4. Ambulatory Surgery Center Utilization for Upper Urinary Tract Stone Disease
ASC utilization grew significantly in both women and men ($p < 0.01$ for both). No evidence exists for differential rates of growth among male and female stone patients for use of ASCs ($p = 0.44$).

Appendix

Procedure Codes

50040 - Nephrostomy, nephrotomy with drainage
50060 - Nephrolithotomy; removal of calculus
50065 - Nephrolithotomy; secondary surgical operation for calculus
50075 - Nephrolithotomy; removal of large staghorn calculus filling renal pelvis and calyces (including anatomic pyelolithotomy)
50080 - Percutaneous nephrolithotomy or pyelolithotomy with or without dilation, endoscopy, lithotripsy, stenting, or basket extraction; up to 2cm
50081 - Percutaneous nephrolithotomy or pyelolithotomy with or without dilation, endoscopy, lithotripsy, stenting, or basket extraction; over to 2cm
50130 - Pyelotomy with removal of calculus
50392 - Introduction of intracatheter or catheter into renal pelvis for drainage and/or injection, percutaneous
50393 - Introduction of ureteral catheter or stent into ureter through renal pelvis for drainage and/or injection, percutaneous
50398 - Change of nephrostomy or pyelostomy tube
50561 - Renal endoscopy through established nephrostomy or pyelostomy, with or without irrigation, instillation, or ureteropyelography, exclusive of radiologic service; with removal of foreign body or calculus
50590 - Shock wave lithotripsy
50610 - Ureterolithotomy; upper one-third of ureter
50620 - Ureterolithotomy; middle one-third of ureter
50630 - Ureterolithotomy; lower one-third of ureter
52005 - Cystourethroscopy, with ureteral catheterization, with or without irrigation, instillation, or ureteropyelography, exclusive of radiologic service
52320 - Cystourethroscopy with removal of ureteral calculus
52325 - Cystourethroscopy with fragmentation of ureteral calculus
52330 - Cystourethroscopy with manipulation, without removal of ureteral calculus
52332 - Cystourethroscopy, with insertion of indwelling ureteral stent
52334 - Cystourethroscopy with insertion of ureteral guide wire through kidney to establish a percutaneous nephrostomy, retrograde
52335 - Cystourethroscopy, with ureteroscopy and/or pyeloscopy; diagnostic
52336 - Cystourethroscopy, with ureteroscopy and/or pyeloscopy; with removal or manipulation of calculus (ureteral catheterization is included)
52337 - Cystourethroscopy, with ureteroscopy and/or pyeloscopy; with lithotripsy (ureteral catheterization is included)
52351 - Cystourethroscopy, with ureteroscopy and/or pyeloscopy; diagnostic
52352 - Cystourethroscopy, with ureteroscopy and/or pyeloscopy; with removal or manipulation of calculus
52353 - Cystourethroscopy, with ureteroscopy and/or pyeloscopy; with lithotripsy
560 - Trans urethral removal of obstruction from renal pelvis or ureter; ureteroscopy with removal of stone or blood clot
561 - Ureteral meatotomy
562 - Ureterostomy
598 - Ureteral catheterization
5501 - Nephrotomy
5502 - Nephrostomy
5503 - Perc nephrostomy w/o fragmentation
5504 - Perc nephrostomy with fragmentation
5511 - Pyelotomy
5593 - Replacement of nephrostomy tube
5631 - Diagnostic ureteroscopy

5995 - Ultrasonic fragmentation of urinary stones

8774 - Retrograde pyelogram

9851 - Shock wave lithotripsy