Changing Gender Prevalence of Stone Disease

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Purpose: Recent studies suggest that the incidence of renal stone formation has been increasing and the male predominance of nephrolithiasis is decreasing, which may be due to changes in diet and lifestyle. We examined changes in the prevalence by gender of inpatient hospital discharges for urinary stone disease.

Materials and Methods: The Nationwide Inpatient Sample was used for analysis. Discharges with an International Classification of Diseases, 9th revision, Clinical Modification principal diagnosis of 592.0 (calculus of kidney) or 592.1 (calculus of ureter) from 1997 to 2002 were included in the investigation.

Results: An estimated mean ± SE 1,013,621 ± 19,310 discharges for stone disease occurred from 1997 to 2002. Discharges for renal calculus increased by 18.9% during the study period ($p < 0.001$), while discharges for ureteral calculus remained relatively constant. After adjusting for population changes discharges for renal calculi increased by 14.2% ($p = 0.002$). In females discharges for renal calculi increased by 21.0% and discharges for ureteral calculi increased by 19.2% (each $p < 0.001$). After adjusting for population changes renal calculus and ureteral calculus discharges in females increased by 22.0% ($p = 0.001$) and 14.5% ($p = 0.005$), respectively.

Conclusions: In this nationally representative sample the population adjusted rate of discharges for stone disease in females dramatically increased from 1997 to 2002. This alteration represents a change in the prevalence by gender of treated stone disease from a 1.7:1 to 1.3:1 male-to-female ratio. It may reflect variations in the underlying prevalence by gender of stone disease. We speculate that the increasing incidence of nephrolithiasis might be due to lifestyle associated risk factors, such as obesity.

Key Words: calculi, epidemiology, female, kidney, ureter

Recent evidence suggests that the prevalence of stone disease in the United States may be increasing.[1,2] Additionally, the classic 3:1 male predominance of stone disease may be changing. These alterations may be due to risk differences for stone disease between women and men.[3]

Given this background, we used NIS data to examine changes in the prevalence of treated stone disease in the United States during 1997 to 2002. In the context of gender related risk differences we hypothesized that changes in stone disease prevalence would differ between men and women.

METHODS

Data Source

Discharge estimates for the management of ureteral and renal calculi were derived from the NIS, which is part of the Healthcare Cost and Utilization Project, sponsored by the Agency for Healthcare Research and Quality. The NIS is a publicly available database of inpatient stays compiled from hospitals across the United States. This data set includes 5 to 8 million inpatient stays annually, representing a 20% stratified sample of hospitals in the United States. Inpatient stays from all payers, including Medicaid, Medicare, private insurance and uninsured individuals, are included.[4] Hospitals are grouped into 60 strata by census region, urban or rural location, teaching status, control (nonfederal public, private, etc) and bed size. Administrative data are collected on all discharges for a 20% sample of hospitals per stratum. Discharges are weighted to produce nationally representative estimates of health care resource use.[5]

Study Population

Inpatient stays for stone disease were identified using ICD9-CM codes. Patients with a principal diagnosis of 592.0 (calculus of kidney) or 592.1 (calculus of ureter) were included in the analysis. Patient characteristics (gender, race and primary payer) were recorded by NIS administrators from hospital reported records. Data on 1997 to 2002 were used to assess trends in the inpatient management of stone disease with time. The final sample included 204,594 discharges, which were used to generate national estimates of inpatient resource use for stone disease.

We use the term treated stone disease in the epidemiological sense, that is stone disease that came to the attention of a medical provider, as opposed to stone disease that may be unidentified in the population.

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The Duke University Medical Center institutional review board determined that the study was exempt from approval.

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Statistical Analysis

NIS data consists of a well-defined sample of hospital discharges, from which national estimates of inpatient resource use are derived using well established methodology. National estimates were generated with SAS® 9.1 using an ultimate cluster variance model to account for the design of the NIS.[5] NIS sampling weights were used in all analyses. Population adjusted estimates were generated using intercensal population figures from the United States Census Bureau.[6] Trends were analyzed using univariate regression models with year as the independent variable and 2-sided $\alpha < 0.05$ was considered statistically significant. The institutional review board of Duke University Medical Center determined that the study was exempt from the requirement for approval.

RESULTS

An estimated mean ± SE 1,013,621 ± 19,310 discharges for stone disease occurred during the study period. Of these discharges 30.9% were for renal calculi and 69.1% were for ureteral calculi (table 1). Males comprised 58.6% of the study cohort. Mean patient age was 48.1 years (95% CI 47.9–48.2) and mean length of stay was 2.3 days. White patients predominated the study population, comprising 62% of national discharges for the period, although race was not identified for almost 1 of 4 discharges. Of patients discharged for stone disease 60.0% were covered by private insurance.

The total number of discharges for stone disease increased by 5.7% from 1997 to 2002 (p = 0.036, fig. 1). The number of discharges for renal calculi increased by almost 20% from 48,602 ± 1,438 to 57,810 ± 1,986 (p = 0.001). Discharges for ureteral calculi were relatively constant with an estimated 118,516 ± 3,815 discharges in 2002, representing a 0.4% increase (p = 0.459). When stratified by gender, discharges for stone disease in females increased by 22% from 64,144 ± 1,711 in 1997 to 78,120 ± 2,261 in 2002 (p = 0.001). Discharges for males did not significantly change from 1997 to 2002.

Discharges for ureteral plus renal calculi increased sharply in women from 1997 to 2002 (fig. 2). For renal calculi female discharges increased by 21.0% (p = 0.001), while discharges for ureteral calculi in females increased by 19.2%

TABLE 1. *Study cohort characteristics*

Characteristic		
No. total discharges (%):	1,013,621	(100)
Renal calculus	313,536	(30.9)
Ureteral calculus	700,085	(69.1)
No. gender (%):		
M	594,228	(58.6)
F	419,334	(41.4)
No. race (%):*		
White	626,763	(61.8)
Black	40,277	(4.0)
Hispanic	64,111	(6.3)
Other	31,600	(3.1)
No. payer (%):		
Medicare	208,189	(20.5)
Medicaid	77,655	(7.7)
Private insurance	607,611	(59.9)
Self	77,013	(7.6)
Other	37,518	(3.7)
Median age (95% CI)	48.1	(47.9–48.2)
Median days hospitalized (95% CI)	2.3	(2.2–2.3)

* Not available for 250,870 admissions (24.7%).

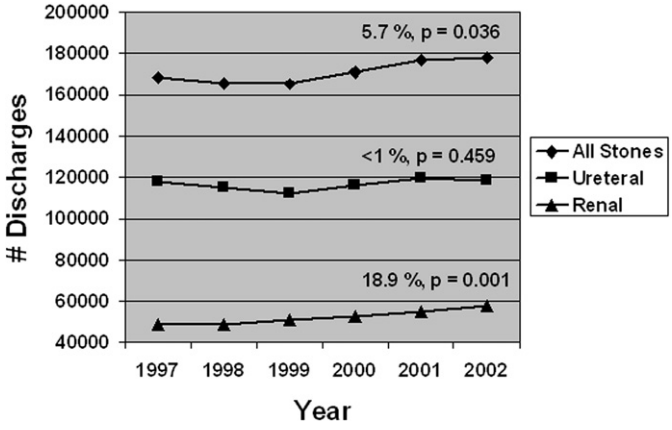

FIG. 1. Number of stone discharges by year in 1997 to 2002

(p = 0.003). By 2002 males and females had an almost equal number of discharges for renal calculus disease (fig. 2). In males discharges for renal calculi increased by 12% (p = 0.002), while discharges for ureteral calculi decreased by 10% (p = 0.038).

Table 2 shows age and population adjusted estimates of discharges for stone disease. While the prevalence of total stone discharges and ureteral calculus discharges did not change significantly, the increase in renal calculus discharges persisted. Renal calculus discharges increased by 10.8% during the study period from 18.5/100,000 to 20.5/100,000 population (p = 0.002). In females renal calculi increased by 22.0% from 16.4/100,000 to 20.0/100,000 population (p = 0.001). Male renal calculus discharges increased by 7.7% (p = 0.013).

Overall the discharge rate for ureteral calculi decreased by 3.7%, although this change was not statistically significant (p = 0.696). However, in females the ureteral calculus discharge rate increased by 14.5% from 29.7/100,000 to 34.0/100,000 (p = 0.007). The increase in females was offset by a 13.4% decrease in males from 58.0/100,000 to 50.2/100,000 (p = 0.021).

DISCUSSION

Recent evidence suggests that the prevalence of stone disease may be increasing in the United States.[1,2] The prevalence of stone disease increased from 3.8% to 5.2% in the National Health and Nutrition Examination Survey.[2] Similarly the Urological Diseases in America project documented sharp increases in office visits, ambulatory procedures and inpatient hospitalizations for upper tract urinary lithiasis during the 1990s.[1] The correlation of increasing stone prevalence in Japan with the increasing uptake of a Western diet and lifestyle suggests that environmental causes may in part account for changes in the prevalence of stone disease.[7]

Associations between body mass and risk factors for stone disease provide a possible explanation for the influence of environmental factors on nephrolithiasis. For example, a higher proportion of obese patients have hyperuricosuria, gouty diathesis, hypercalciuria and uric acid stones than normal weight controls.[8] Similarly, in 2 large cohorts of patients with stones urinary pH negatively correlated with body mass even when controlling for dietary factors.[9] Fi-