# Prevalence of Urolithiasis in Asymptomatic Adults: Objective Determination Using Low Dose Noncontrast Computerized Tomography

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**Purpose:** The true prevalence of urolithiasis in asymptomatic adults is unknown. Unenhanced computerized tomography represents the gold standard for detection. We evaluated the prevalence and symptomatic incidence of urolithiasis in a large cohort of asymptomatic adults using noncontrast computerized tomography.

**Materials and Methods:** Low dose noncontrast computerized tomography was performed in 5,047 consecutive asymptomatic adults (mean age 56.9 years, 2,747 women and 2,300 men) between 2004 and 2008. Presence, size and location of urinary calculi were recorded. Screening prevalence as well as the incidence of symptomatic stone disease during a 10-year interval (1997 to 2007) was compared against previously established clinical risk factors.

**Results:** The screening prevalence of asymptomatic urolithiasis was 7.8% (395 of 5,047 adults) with an average of 2.1 stones per case (range 1 to 29) and a mean stone size of 3.0 mm (range 1 to 20). During a 10-year period 20.5% (81 of 395) of patients with stones (1.6% of entire screening cohort) had at least 1 symptomatic episode. Males were more likely to have urolithiasis than females (9.7% vs 6.3%, $p < 0.001$). Diabetes (9.0% vs 7.7%, $p = 0.45$), obesity (7.6% vs 7.9%, $p = 0.72$) and age 60 years or older (8.0% vs 7.7%, $p = 0.73$) did not affect prevalence, but diabetes and obesity did correlate with symptom development ($p < 0.001$ and $p < 0.05$, respectively).

**Conclusions:** This objective population based assessment in a large asymptomatic cohort showed an 8% prevalence of urolithiasis. Most cases were unsuspected and remained asymptomatic. Although there was no correlation between asymptomatic urolithiasis and diabetes, obesity or older age, diabetes and obesity were associated with a higher incidence of symptoms over time.

**Key Words:** prevalence; urolithiasis; calculi; tomography, x-ray computed; risk factors

**Abbreviations and Acronyms**

BMI = body mass index

CT = computerized tomography

CTC = computerized tomography colonography

RF = risk factor

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UROLITHIASIS, or urinary stone disease, represents an enormous clinical and financial burden to the United States health care system. Urolithiasis accounts for more than 2 million office visits and nearly 200,000 hospital admissions each year with an estimated annual cost of more than $2 billion in the United States alone.[1] Studies also suggest that the incidence of symptomatic stone disease is increasing.[1,2] Despite the obvious importance of this disease the true prevalence has not been established by objective criteria. Previous attempts at establishing prevalence in large scale series

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have used either patient recall or ICD-9 coding, effectively ignoring asymptomatic urolithiasis.[2,3] Similarly only limited data exist regarding the incidence of symptomatic disease among all patients with urolithiasis. Although we do know that the recurrence rate for patients with prior symptomatic stone disease exceeds 50%, the incidence of symptomatic transition from an asymptomatic state is unknown.[4,5]

A host of clinical risk factors have been associated with urolithiasis, including but not limited to age older than 60 years, male gender, diabetes or insulin resistance, increased BMI, as well as a number of specific dietary and urinary factors. Various diagnostic methods have been used for detecting urinary stones including excretory urography, abdominal radiography, sonography, magnetic resonance imaging and CT. However, CT is clearly the diagnostic gold standard with an accuracy that approaches 100% due to the increased attenuation values of urinary calculi.[6–8] CT not only represents a noninvasive means to identify, quantify, size and locate urinary stones, it can also assess for the presence of obstruction and suggest alternative diagnoses in patients with flank or groin pain.[9]

In this study we assessed the prevalence of urolithiasis in an asymptomatic United States adult population using low dose noncontrast CT, as well as the development of symptomatic stone disease during a 10-year period. Prevalence of asymptomatic urolithiasis and the onset of symptomatic disease were correlated with reported clinical risk factors.

## MATERIALS AND METHODS

This Health Insurance Portability and Accountability Act compliant retrospective study was performed under an institutional review board approved protocol. The need for signed informed consent for this investigation was waived.

Unenhanced low dose CT was performed on 5,047 consecutive asymptomatic adults undergoing routine CT colonography screening at a single institution during a 4-year interval (between 2004 and 2008) using a clinically validated technique.[10,11] The demographic data for this screening cohort are provided in table 1. Because the noncontrast CT imaging for colonography covers the entire urinary system and is equivalent to a CT performed for urolithiasis evaluation, no additional scanning or radiation dose was necessary for this study.

The specific low dose noncontrast multidetector CT protocol used in this study has been previously described.[10]

**Table 1.** *Demographic and clinical characteristics of the screening cohort*

| | |
|---|---|
| Mean ± SD age | 56.9 ± 7.3 |
| No. age 60 yrs or older (%) | 1,480 (29) |
| No. overwt + obese (%) | 3,296 (65) |
| No. obese (%) | 1,369 (27) |
| No. diabetes mellitus (%) | 324 (6) |

The effective radiation dose for the supine CT series is approximately 2.5 mSv, which is substantially lower than typical contrast enhanced CT and slightly less than annual background radiation. All studies were performed on 8 or 16-channel multidetector CT scanners (LightSpeed™ series). The extracolonic supine CT images were prospectively reviewed by 1 of 5 abdominal radiologists on a standard picture archiving and communication system workstation at 5 mm thick sections reconstructed at 3 mm intervals. The presence, number, size and location of urinary stone disease was recorded, and subsequently confirmed on retrospective review. Stones were identified by 1 of 5 board certified abdominal radiologists. Care was taken to exclude vascular or other nonstone related calcifications from renal calculi.

Demographic data and potential clinical risk factors for urolithiasis were recorded from a combined assessment of the screening intake form (eg age, gender, race, height, weight and BMI) and the electronic medical record (diabetes). Chart review included comprehensive text searches with pertinent ICD-9 code searches to identify diabetic patients. Overweight or obese status was defined as a BMI of 25 $kg/m^2$ or greater and obesity was defined as BMI 30 $kg/m^2$ or greater. The older age group was defined as 60 years or older. The prevalence data among this screening cohort for these clinical risk factors are listed in table 1.

Symptomatic stone disease was determined by additional radiological imaging, chart review of pertinent clinical visits, urological emergent or urgent care and pertinent ICD-9 codes. A 10-year time horizon from 1997 to 2007 was included to evaluate the incidence of symptomatic urolithiasis. Patients in whom symptomatic stone disease developed after CT detection were further subcategorized. RF assessment for symptomatic disease was performed. Fisher's exact test was used to assess demographic and clinical risk factors for the association with urolithiasis.

## RESULTS

The prevalence of urolithiasis at noncontrast CT in this asymptomatic cohort of 5,047 consecutive adults was 7.8% (395 cases) with a total of 814 calculi identified. Mean stone size was 3.0 mm (range 1 to 20). The distribution of calculi according to number per patient, the largest stone per patient and the overall distribution of stone size are shown in figure 1. The mean number of stones per patient was 2.1, ranging from a single calculus in 243 patients up to 29 stones in 1 patient (fig. 2). Of 395 patients 152 (38.5%) had more than 1 stone but only 16 (4.1%) had more than 5 stones. Only 14 (1.7%) of 814 urinary stones measured 1 cm or larger. Stones were present on the right side in 242 patients and on the left in 239, with bilateral disease in 87.

Of the 395 total patients with urinary stones 391 (99.0%) had nephrolithiasis (renal calculi), 6 had ureteral calculi and 2 had bladder calculi. Of the 6 patients with unsuspected asymptomatic ureteral