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Stone Composition Among First-Time Symptomatic Kidney Stone Formers in the Community

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Abstract

Objective: To determine the variation in kidney stone composition and its association with risk factors and recurrence among first-time stone formers in the general population.

Patients and Methods: Medical records were manually reviewed and validated for symptomatic kidney stone episodes among Olmsted County, Minnesota, residents from January 1, 1984, through December 31, 2012. Clinical and laboratory characteristics and the risk of symptomatic recurrence were compared between stone compositions.

Results: There were 2961 validated first-time symptomatic kidney stone formers. Stone composition analysis was obtained in 1508 (51%) at the first episode. Stone formers were divided into the following mutually exclusive groups: any brushite (0.9%), any struvite (0.9%), any uric acid (4.8%), and majority calcium oxalate (76%) or majority hydroxyapatite (18%). Stone composition varied with clinical characteristics. A multivariable model had a 69% probability of correctly estimating stone composition but assuming calcium oxalate monohydrate stone was correct 65% of the time. Symptomatic recurrence at 10 years was approximately 50% for brushite, struvite, and uric acid but approximately 30% for calcium oxalate and hydroxyapatite stones ($P<.001$). Recurrence was similar across different proportions of calcium oxalate and hydroxyapatite (P for trend=.10). However, among calcium oxalate stones, 10-year recurrence rate ranged from 38% for 100% calcium oxalate dihydrate to 26% for 100% calcium oxalate monohydrate (P for trend=.007).

Conclusion: Calcium stones are more common (93.5% of stone formers) than has been previously reported. Although clinical and laboratory factors associate with the stone composition, they are of limited utility for estimating stone composition. Rarer stone compositions are more likely to recur.

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Symptomatic kidney stones are prevalent in 7.2% to 7.7% of the US adult population[1,2] and are often classified by stone composition.[3-6] Clinical practice guidelines disagree, with urologic associations recommending[7,8] but the American College of Physicians not recommending stone compositional analysis in all stone formers.[9] Prior studies[10-12] have classified stone composition in the following overlapping groups: any calcium oxalate monohydrate (COM), 40% to 60%; any calcium oxalate dihydrate (COD), 40% to 60%; any hydroxyapatite, 20% to 60%; any brushite, 2% to 4%; any uric acid, 5% to 10%; any struvite, 5% to 15%; and any cystine, 1% to 2.5%. The common calcium stone (calcium oxalate and/or hydroxyapatite) is thought to occur in 75% to 85% of stone formers. However, most prior studies assessed stone composition in referral centers of prevalent stone formers that may be enriched for stone compositions that are more likely to recur or require surgery. Stone composition characteristics of first-time (incident) stone formers in the general population are unknown.

In practice, stone composition is often not available because the stone is not collected. Clinical and laboratory characteristics of the patient are often used to estimate composition.[3] However, the accuracy of estimating stone composition

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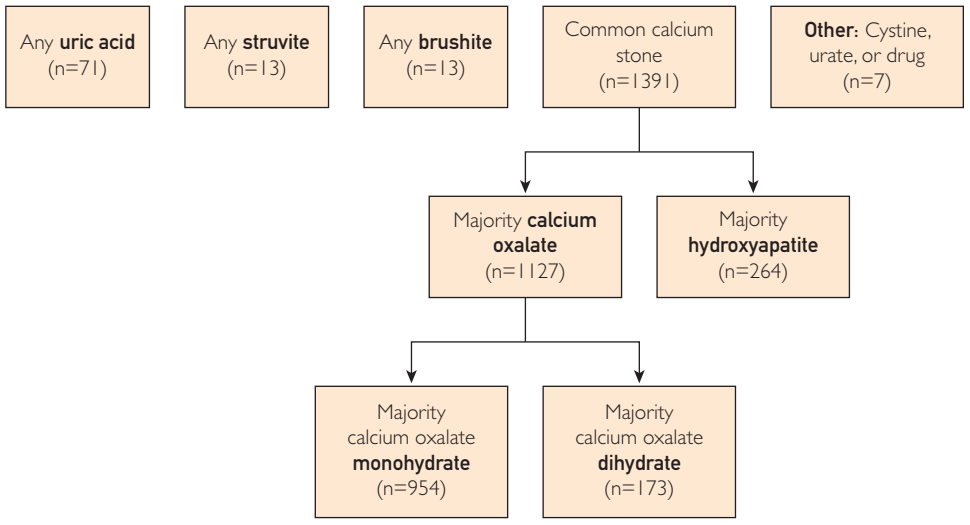

FIGURE 1. Stone composition classification of first-time stone formers in Olmsted County, Minnesota.

is largely unknown. The stability of stone composition between episodes and the extent to which stone composition predicts recurrence in the community is also unclear. To address these important questions, we carefully analyzed a large population-based cohort of first-time symptomatic stone formers. Our goals were to (1) characterize stone composition of first-time stone formers in detail, including composition stability with recurrence; (2) determine whether stone composition can be estimated when not available; and (3) determine whether risk of recurrence differs by stone composition.

METHODS

Study Sample

After institutional review board approval, first-time (incident) symptomatic kidney stone formers in Olmsted County, Minnesota, from January 1, 1984, through December 31, 2012, were identified by diagnostic codes and then validated and detailed by medical record review using the Rochester Epidemiology Project[13] as described in the Supplemental Methods (available online at http://www.mayoclinicproceedings.org).

Stone Composition

All stone composition reports in these stone formers were identified and reviewed. Stone composition analysis was not routine for each episode, especially after first obtained. Thus, stone composition was assessed at the first episode and compared among the first, second, and third available composition reports (regardless of episode number). Stone compositions were determined by infrared spectroscopy (Supplemental Methods). Stone formers were divided into the following mutually exclusive groups: cystine (if any), brushite (if any), struvite (if any), uric acid (if any), and calcium oxalate (if majority) or hydroxyapatite (if majority) (Figure 1). Majority calcium oxalate stones were further subclassified as COM (if majority) or COD (if majority). Other compositions (eg, urate and drugs) were too rare for meaningful analysis and excluded.

Statistical Analyses

A trend in the ratio of stone compositions (common calcium vs other less common compositions) among the first, second, and third available composition reports was assessed using a logistic generalized estimating equation model. Clinical and laboratory characteristics were compared across stone composition at the first episode using Kruskal-Wallis and Wilcoxon tests for continuous variables and χ^2 tests for nominal variables. A model to estimate stone composition at the first episode from clinical and laboratory characteristics was developed using multinomial logistic regression. The highest probability stone composition as determined by the model was