shopping" for testing and evaluation to expedite listing and increase equity in kidney transplantation.[10] While this process addresses systemic barriers to testing and evaluation for the transplant candidates, fast-track clinics would not address the provision of information about the option of kidney transplantation in the referral stage. Could we devise strategies to "fast-track" the KTPI process for our dialysis patients, and thereby increase the likelihood of evaluation and eventual listing for transplant? As suggested by Salter and colleagues, the presentation and discussion of alternate treatment modalities are an important part of the consent process for dialysis. As such, their findings suggest that we should begin the process of KTPI very early—ideally, before the initiation of long-term intermittent dialysis. But just as informed consent is a process, and not a one-time event, KTPI is likely to require repeated emphasis thereafter because of the potential barriers to effective communication that we have noted. Moreover, merely documenting that KTPI has occurred is inadequate. We need to hear directly from patients that they are fully aware of their options and understand them.

DISCLOSURES

None.

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See related article, "Patient- and Provider-Reported Information about Transplantation and Subsequent Waitlisting," on pages 2871–2877.

A Nomogram for the Prediction of Kidney Stone Recurrence

Brian H. Eisner* and David S. Goldfarb†

*Department of Urology, Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts; and †New York Harbor Veterans Affairs Healthcare System and New York University School of Medicine, New York, New York

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In the 1980s, Ljunghall and Danielson reported a prospective study of renal stone recurrences.[1] Among a group of 54 patients with their first episode of renal colic, 53% of the patients developed recurrences within an 8-year period, with the highest number of recurrences taking place during the first year after the initial renal colic episode.[1] Fast-forward 30 years to the article by Rule *et al.* in this issue of *JASN*, in which the authors have commendably created the Recurrence of Kidney Stone (ROKS) nomogram using the medical records of >2000 residents of Olmsted County, Minnesota.[2] Rule *et al.* selected participants who experienced a first kidney stone episode, determined their rate of recurrence over the ensuing years, and then, using a multivariable model, developed a tool to turn participants' characteristics at baseline into estimates of recurrence at varying times.[2] This article highlights several important aspects of kidney stone disease that are particularly relevant in this modern era of preventive medicine, from both the metabolic and surgical standpoints.

Using the simplest interpretation of the data, the nomogram provides clinicians with reasonable prediction values for the recurrence of stone disease. A majority of patients who come to the clinic (whether staffed by an internist, nephrologist, or urologist) with their first symptomatic kidney stone episode will immediately ask if it will happen again and what they might do to prevent it. We can confidently counsel them, based on the data presented here, that symptomatic recurrence rates are about 11% at 2 years, 20% at 5 years, and 31% at 10 years. At the

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Correspondence: Dr. Brian H. Eisner, Department of Urology, Massachusetts General Hospital, Harvard Medical School, GRB 1102, 55 Fruit Street, Boston, MA 02114. Email: beisner@partners.org

very least, these numbers may motivate stone formers to change their diet (low sodium, low animal protein, normal calcium) and drinking habits (fluid consumption of >2 L/d) in an effort to decrease the rate of recurrence. Both diet and fluids have been shown to be effective in reducing kidney stone recurrence in randomized controlled trials.[3,4]

To take this a step further, these recurrence rates may also argue for the consideration of pharmacotherapy in some patients with higher recurrence rates. In urologic practice in particular, there are few common practices that are supported by as such strong evidence as supports pharmacotherapy for kidney stone disease. Level 1 evidence from randomized controlled trials exists for the use of thiazides, citrate, and, in patients with hyperuricosuria and normocalciuria, allopurinol for prevention of calcium oxalate stones.[5–7]

Patients are not the only ones who may need motivation to work on stone prevention using dietary or pharmacologic interventions. A recent article using medical claims data reported that among stone formers at high risk for recurrence, <10% will be offered the opportunity to perform a 24-hour urine collection by their treating physician, suggesting that there is great room for improvement in the primary prevention of kidney stone disease on physicians' parts as well.[8] This deficiency is especially notable in light of the recent publication of the American Urological Association (AUA) guidelines on the medical management of kidney stones (written by a committee that included representatives of the American Society of Nephrology and the AUA).[9] The guidelines strongly endorse physicians' efforts to evaluate stone formers and offer evidence-based diet and pharmacologic therapies to prevent stone recurrence.

The nomogram also gives valuable data on the surgical treatment of stone disease that may help guide clinician and patient decision making. Patients with a single stone who underwent a surgical procedure to remove it did not experience any change in their recurrence risk, but the presence of "incidental" nonobstructing stones influenced the effect of surgery on recurrence risk. For patients who had nonobstructing stones at the time of the initial episode, surgery was associated with a decrease of 35% in the risk of recurrence. These data make sense of course. It is logical that a person who passes a stone but has three other stones in his or her kidneys is more likely to have a future event than a patient who passes a single stone and is otherwise stone free. This reasoning may also play a role in the selection of surgical procedure. Often, when performing shockwave lithotripsy, surgeons will target the offending stone that is causing the acute episode, whereas other nonobstructing stones are left to be observed or managed expectantly. On the other hand, when performing ureteroscopic lithotripsy or percutaneous nephrolithotomy, one can treat the offending stone and remove other nonobstructing stones in the kidney in the same setting (*i.e.,* renal colic episodes "waiting to happen"). This advantage has further implications as our health care system moves toward managing diseases with episode-based bundled payments: There is clearly value not only to the patient, but perhaps to the health care system if potential "future episodes" can be treated with a single ureteroscopy or percutaneous nephrolithotomy.[10]

For this nomogram to demonstrate value, it now should be tested prospectively in additional populations of stone formers. The tool can be considered comparable to predictive nomograms such as the World Health Organization tool FRAX (http://www.shef.ac.uk/FRAX/), which estimates 10-year bone fracture probability. FRAX has evolved over the years, and has been validated in multiple populations and by meta-analyses. Its use in fracture risk prediction has important implications for development of practice guidelines, evaluation of drug efficacy, and various aspects of healthcare economics.[11] Like FRAX, the information required for ROKS is easily and inexpensively obtained (http://qxmd.com/ROKS). It can be widely implemented in multiple kidney stone clinics so that additional ethnic groups, in diverse clinical settings, and from diverse populations can be included and observed prospectively. By including the residents of Olmsted County, and not patients referred from outside that region to the Mayo Clinic, the authors analyzed a population that may be more representative of the average American community and less similar to the more complex patients seen in a tertiary kidney stone referral clinic. The tool should be tested in these various settings.

An interesting aspect of how this tool's utility will extrapolate to other locations is the latitude of Olmsted County, Minnesota, where the Mayo Clinic and the study's participants are located. Kidney stone prevalence is greater in warmer climates presumably because higher ambient temperature leads to reduced urine volume and higher concentrations of stone-forming salts.[12–14] On the basis of previously published data and the current nomogram, it follows that stone recurrence in Rochester, Minnesota, where monthly average high temperatures are <4.4°C for 7 months per year, may actually underestimate recurrence rates in lower latitudes and warmer climates.

Whether additional variables can be added to increase the usefulness of this tool will be of interest in the future. For instance, the authors did not include 24-hour urine collections as possible variables that could predict risk because these data were often not available. Although 24-hour collections have not conclusively been shown to offer a superior way of preventing stone recurrence, the AUA guideline panel endorsed their use (expert opinion).[9] The committee thought that they allow prescription of dietary recommendations specific to individual stone formers, rather than more generic ones. Although potassium citrate and thiazides may offer benefit if prescribed for calcium stone formers regardless of urine chemistry, most practitioners prefer a strategy targeting specific lithogenic risk factors. An additional possible variable that we expect to see determined more frequently will be the results of genetic testing.[15] Convincing evidence demonstrates that kidney stones in the general population have a hereditary component; however, the genes responsible remain obscure. We can only speculate and anticipate that genetic testing will have an effect on predicting kidney stone recurrence rates with time.

Kidney stones have recently been linked to a wide variety of comorbidities, based on data from these same authors at the Mayo Clinic and many others. CKD, hypertension, diabetes, metabolic syndrome, osteoporosis and fracture, and coronary artery disease are examples. It is likely that all of these disorders share common risk factors to account for these associations. Whether a causal component exists in either direction remains uncertain. Also uncertain, in our opinion, are the reasons why general internists and primary care practitioners are involved in the secondary prevention and management of their patients' hypertension, diabetes, metabolic syndrome, osteoporosis, and coronary artery disease, but not in their kidney stone disease. The AUA guidelines call for a more widespread involvement of physicians, including of urologists and nephrologists, in the evaluation and prevention of stones. We hope that ROKS, an attractive, easy-to-use, and eventually, a more fully validated nomogram, will change the current situation and lead to more concerted efforts to prevent kidney stone recurrence.

DISCLOSURES

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See related article, "The ROKS Nomogram for Predicting a Second Symptomatic Stone Episode," on pages 2878–2886.