Increased Water Intake as a Prevention Strategy for Recurrent Urolithiasis: Major Impact of Compliance on Cost-Effectiveness

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Purpose: We evaluated the economic impact of preventing recurrent stones using a strategy of increased water intake and determined the impact of compliance on cost-effectiveness for the French health care system.

Materials and Methods: A Markov model was constructed to compare costs and outcomes for recurrent kidney stone formers with less than 2 L vs 2 L or more daily fluid intake. Model assumptions included an annual prevalence of 120,000 stone episodes in France, 14.4% annual risk of stone recurrence and a 55% risk reduction in subjects with adequate water intake. Costs were based on resource use as estimated by a panel of experts and official national price lists. Outcomes were from the perspective of the public health payer, and encompassed direct and indirect costs.

Results: The total cost of an episode of urolithiasis was estimated at €4,267 including the cost of treatment and complications. This corresponds to an annual budget impact of €88 million for recurrent stones based on 21,000 stone events. Assuming 100% compliance with fluid intake recommendations of 2 L daily, 11,572 new stones might be prevented, resulting in a cost savings of €49 million. Compliance with water intake in only 25% of patients would still result in 2,893 fewer stones and a cost savings of €10 million. Varying the costs of managing stones had a smaller impact on outcomes since in many patients stones do not form. Varying the incidence of complications did not change the incidence of stones and had a negligible effect on overall cost.

Conclusions: Preventing recurrent urolithiasis has a significant cost savings potential for a payer as a result of a reduced stone burden. However, compliance is an important factor in determining cost-effectiveness.

Key Words: water-electrolyte balance, fluid therapy, urolithiasis, recurrence, cost-benefit analysis

Abbreviations and Acronyms

CKD = chronic kidney disease

Accepted for publication August 13, 2012.

Financial interest and/or other relationship with Danone.

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National health care expenditures are continually increasing such that economic considerations are impacting all aspects of medical care.[1] Urolithiasis is a disease of high prevalence and morbidity resulting in a significant cost burden. The overall prevalence of stone disease is 5% to 9% in Europe and 7% to 13% in North America, leading to billions of dollars in annual health care costs.[2,3] An important aspect of urolithiasis that contributes to cost and morbidity is the recurrent nature of the disease with approximately 50% recurrence by 5 years.[4] Various strategies have been recommended to decrease

0022-5347/13/1893-0935/0
THE JOURNAL OF UROLOGY®

http://dx.doi.org/10.1016/j.juro.2012.08.254
Vol. 189, 935-939, March 2013
Printed in U.S.A.

stone recurrence including increased water intake, dietary modifications and medication. Several prospective studies have demonstrated a risk reduction of 50% in patients who drink a high volume of water compared with typical water intake.[5] There is also a benefit associated with dietary modification such as a low salt intake.[6] Medications, while efficacious when targeted to patients with metabolic problems, have associated costs and side effects with resultant poor compliance.[7]

The cost-effectiveness of strategies to reduce stone recurrence has been studied previously but has primarily focused on medical management rather than conservative measures (fluid and dietary changes).[8–10] A cost-effectiveness model comparing medical management and conservative treatments found conservative measures to be less costly but associated with a higher risk of recurrence.[4] However, prior studies did not take into account the long-term complications that can occur as a result of stone disease such as pyelonephritis and CKD, nor did they evaluate variations in compliance or effectiveness of treatment.[6,11] In this study we estimated the cost-effectiveness of increased water intake in patients with recurrent stones, taking into consideration variation in compliance with water intake, and variation in risk reduction and disease prevalence.

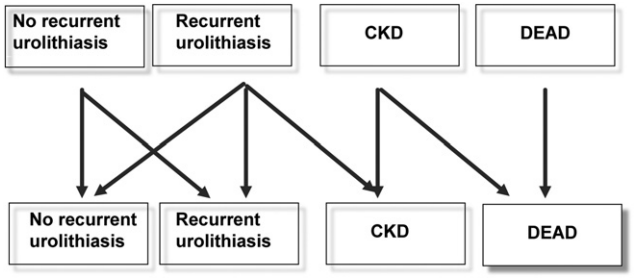
METHODS

A decision analytic model was developed to estimate the cost-effectiveness of adequate water intake (2 L or more per day) vs average water intake (less than 2 L daily).[5] Using the French health care system as an example, the analysis was performed for a hypothetical cohort of persons with a history of urolithiasis and from the perspective of the public health payer (French Social Security). Data sources included published literature, clinical trials, official French price/tariff lists and national population statistics. A French expert validated the framework for the model (structure, assumptions and data sources) based on the specifics of the French health care setting.

Model Design

We previously published a Markov model to evaluate the cost-effectiveness of increased fluid intake in the primary prevention of stones.[12] We modified this Markov model to apply it to patients with a history of urolithiasis (see figure). During each yearly cycle patients could have any of the states of no recurrent urolithiasis, recurrent urolithiasis, CKD or death.

In the Markov model a proportion of patients with recurrent urolithiasis will experience complications (pyelonephritis) which are included in the model as events. End stage CKD (dialysis, transplantation) may develop in a person in whom urolithiasis develops. A subject will be at risk for death in any given year.



Markov analysis

Study Population, Time and Setting

Approximately 80% of the French population drinks less than 2 L of water per day, and we assume that patients with urolithiasis have drinking habits similar to those of the average French population.[13] The base case analysis for the health economic analysis was based on a 25-year followup. This is important to adequately capture the long-term impact of recurrent urolithiasis due to the potential for the resulting long-term morbidity and mortality captured in the model. The perspective of the study in the base case analysis was that of the French payer, and included medical costs as well as indirect costs due to lost productivity.

Cost Assessment

The costs and clinical event probabilities in this model have been previously published.[12] The cost and stone events of subjects in each arm (2 L or more daily and less than 2 L daily) were based on the likelihood of recurrence, risk reduction based on high fluid intake, and risk of complications such as pyelonephritis, CKD and death. We corrected all costs to 2009 costs since there were no inflation data for 2010. A discount rate of 3% was applied for economic outcomes and clinical outcomes.

Base Case Analysis

Probability of urolithiasis recurrence. The prevalence of urolithiasis in the general French population was estimated at 120,000.[14] The risk of stone recurrence in patients with prior stones was based on a French study that demonstrated a 14.4% annual recurrence rate.[14] This finding is similar to a report by Borghi et al showing a risk of recurrence of 37.8% in 3 years, which is an annual risk of 12.6%.[5] The assumption is that the prevalence of urolithiasis corresponds with 80% of the current population drinking less than 2 L water per day and the other 20% drinking at least 2 L daily.

Risk reduction of stone recurrence based on high water intake. We assumed a 55% risk reduction in recurrent stones based on a randomized prospective study of high water intake vs standard water intake in stone formers (12.1% with and 27.0% without high water intake).[5]

Urolithiasis and risk of end stage CKD. The REIN report found that 0.8% of end stage renal failure results from urolithiasis.[15] The prevalence of end stage CKD is approximately 70,000 and the annual incidence is approximately 15% (10,500).[16] The annual incidence of CKD due to urolithiasis is 0.8% of 10,500 (84). Thus, the annual risk of