

Compliance of the recurrent renal stone former with current best practice guidelines

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Cite as: *Can Urol Assoc J* 2018;12(3):E112-20. <http://dx.doi.org/10.5489/cuaj.4605>

Published online December 22, 2017

Abstract

Introduction: Patient compliance to best practice guidelines is a significant factor in preventing renal stone recurrence. While patient compliance has been historically poor, there remains a paucity of data in the renal stone setting. We evaluated compliance of the recurrent renal stone former with current Canadian Urological Association (CUA) best practice guidelines.

Methods: A prospective, cross-sectional study design was used to evaluate patient compliance. Recurrent renal stone former patients were consecutively recruited from McMaster's Institute of Urology and completed a one-time questionnaire developed in accordance with CUA best practice guidelines. Questionnaire sections included: 1) demographics; 2) interaction(s) and satisfaction with their healthcare provider; and 3) knowledge, attitudes, and compliance with best practices.

Results: A total of 300 patients were enrolled in the study; 55.3% were men, 69.5% had a history of stone surgery, while 23.7% had a positive family history. Participants perceived satisfactory education from their urologist and primary care physician 82.7% and 59.7% of the time, respectively ($p < 0.05$). Nearly a quarter of patients (22.8%) perceived their stone disease to be severe and 67.1% of patients believed in the efficacy of preventative stone measures. Overall, 45.8% of patients were compliant with CUA best practice guidelines. The majority of patients (72.6%) complied with high fluid intake, the most critical stone preventative practice.

Conclusions: Consistent with previous studies, compliance to dietary recommendations in this evaluation of recurrent stone formers was low. Study findings may be attributed to insufficient knowledge translation, lack of perceived disease severity, and/or patient uncertainty in the importance of preventative stone practices.

Introduction

The increasing prevalence of nephrolithiasis is well-recognized worldwide. Renal stone recurrence occurs in up to 50% of patients within the first five years following initial stone development.^{1,2} Moreover, relapses occur more frequently and the time interval between each recurrence is shortened.² Fortunately, stone clinics have shown that patients can reduce their five-year recurrence rate by as much as 60% with changes in lifestyle and dietary habits alone.^{3,4} Similar to many chronic medical conditions, these preventative practices are dependent on patient self-awareness, motivation, and ultimately, compliance.³

The recurrent nature of the disease often results in significant patient morbidity and burdensome healthcare expenditures.⁵⁻⁷ In the U.S. alone, the total cost associated with nephrolithiasis has been estimated to be as high as \$5.3 billion.⁸ This estimation not only includes the treatment of acute consequences of nephrolithiasis, such as pain, surgery, and hospitalization, but also the indirect costs, such as loss of employment.⁸ Economic considerations related to stone disease are known to have a considerable impact on overall healthcare expenses.

Patient compliance has often been a challenge in the prevention and treatment of any chronic disease. It is estimated that as many as 75% of patients consistently fail to follow their clinicians' recommendations when it pertains to preventative health practices.^{9,10} Compliance rates across disease processes vary considerably, and have even shown to be poor for treatments that are deemed highly effective.⁹⁻¹¹ Currently, there is a paucity of literature defining patient compliance to conservative treatment measures within the recurrent renal stone former population. Our study aimed to address this knowledge gap in the urological literature.

The study objective was to evaluate the recurrent stone formers' compliance with current Canadian Urological Association (CUA) best practice guidelines, while gaining insight into patients' understanding of preventative practices and the education they receive from healthcare providers.

Methods

In a single-group, prospective, cross-sectional survey study, renal stone patients seen at the McMaster Institute of Urology located in Hamilton, ON, Canada, were enrolled from August 2015 to September 2016. Potential participants were identified and recruited during their scheduled clinic visit. Eligible participants were known renal stone formers (defined by two or more documented stone occurrences during his/her lifetime) and at least 18 years of age. A research assistant obtained informed consent from all eligible participants and distributed the questionnaire in the clinic waiting room. To limit bias, all surveys were completed prior to the patient-urologist interaction and all participants were instructed that involvement in the study would not influence their care.

Basic survey methodology was used in questionnaire development (e.g., anchored Likert scales, multiple-choice, dichotomous, and short answer questions). The 21 survey questions were designed based on the current CUA best practice guidelines on stone preventative measures (Appendix 1).¹² The questionnaire consisted of three domains. The first included demographics, comorbidities, and previous stone management; the second domain covered previous clinician encounters due to kidney stones and patient satisfaction; and the third consisted of questions directed at patient knowledge, attitudes, and guideline compliance. Research ethics board approval was obtained prior to commencing the study.

The primary outcome measure was compliance of the recurrent renal stone former to the CUA best practice guidelines. Secondary outcome measures included the evaluation of participant characteristics that may influence compliance, including knowledge, education, frequency, and subjective quality of preventative education, perceived severity of their disease, prior stone interventions, and, if applicable, attitudes regarding efficacy of stone-related conservative treatments.

All participants were assigned an identification number to ensure anonymity, and consent forms were stored separately from the surveys. All quantitative data was analyzed via descriptive statistics using IBM SPSS Statistics 22 (IBM Corp, Armonk, NY, U.S.). Correlations were explored for variables within and between survey domains using the Chi-square test for categorical data and t-tests for ordinal data. All tests were two-sided, with a p value of <0.05 defining statistical significance.

Results

Participant characteristics

A total of 300 patients were enrolled in the prospective study. Males comprised the majority of the cohort (n=166; 55.3%). The most frequent stone formers were in their fifth

and sixth decade of life. Participant demographics are outlined in Table 1. Among the study population, 69.6% of participants had a post-secondary education, while 27.3% of participants had a predisposing medical condition. A positive family history was present in 23.7% of the study population. Participants perceived their disease as severe 22.8% of the time. Most participants (68.3%) were unaware of their stone composition, although calcium-based stones were the most frequently declared. The majority of participants (69.5%) had previously undergone surgical stone

Table 1. Participant demographic information

Baseline characteristic	n (%)
Age (range)	
18–25	2.7 (8)
26–40	11.3 (34)
41–60	47 (141)
61+	39 (117)
Gender	
Male	55.3 (166)
Female	44.7 (134)
Level of education	
High school	30.3 (91)
College	39.0 (117)
University	20.3 (61)
Post-graduate	10.3 (31)
Predisposing medical condition	
Inflammatory bowel disease	4.0 (11)
Hyperparathyroidism	1.8 (5)
Medullary sponge kidney	3.3 (9)
Adult polycystic kidney disease	0.7 (2)
Sarcoidosis	0.4 (1)
Gout	2.9 (8)
Diabetes	14.2 (39)
Family history of stone disease	
Yes	23.7 (72)
No	76.3 (228)
Type of kidney stones	
Calcium oxalate	21.7 (63)
Calcium phosphate	1.7 (5)
Uric acid	7.2 (20)
Cystine	1.0 (3)
Unsure	68.3 (198)
Prior stone surgery	
Yes	69.5 (207)
No	30.5 (91)
Number of prior urologist encounters	
0	3.6 (9)
1	20.4 (51)
2–5	48.4 (121)
6–10	16.0 (40)
11+	11.6 (29)

management. Participants more commonly interacted with their urologist in comparison to their primary care provider regarding stone management, with a mean visit frequency of 5.4 and 3.2, respectively.

Attitudes and compliance

Participants stated that they had satisfactory knowledge translation discussions with their urologist and primary care physician 82.7% and 59.7% of the time, respectively ($p < 0.05$) (Fig. 1). When surveyed about their belief in preventative stone treatments, 67.1% of participants were in agreement that preventative practices reduce future stone occurrences (Fig. 2).

Overall, patient compliance to preventative stone practices, as outlined in the current CUA best practice guidelines, was 45.8%. The highest compliance rate was to fluid intake (72.6%). Calcium and salt intake compliance rates were 70.7% and 51.7%, respectively. Compliance to both citrate and protein-best practice recommendations were 13.9% and 19.2%, respectively (Fig. 3). Participant knowledge varied widely based on specific dietary recommendations. Participants demonstrated adequate understanding of fluid intake and its role in prevention; however, knowledge was lacking when assessing adjunct dietary measures (Fig. 4). A significant association was demonstrated between frequency of education by treating urologist and compliance to preventative stone practices ($p < 0.05$).

Discussion

The literature on patient compliance to best practice recommendations has continued to grow rapidly over the past several decades, as the prevalence of chronic disease has increased.⁹ Despite this shift, patients do not always adhere to their clinicians' recommendations, which are primar-

ily derived from published clinical practice guidelines. In addition to poor clinical outcomes and the potential for diminished patient quality of life, patient non-compliance can also be a large economic burden for the healthcare system.^{13,14} Although best practice guidelines have been published for treatment and prevention of recurrent renal stones, there is a gap in the literature that describes detailed compliance issues within the recurrent stone former population.

Our study depicts a poor compliance rate among recurrent renal stone formers with regards to current CUA best practice guidelines. While participants were highly compliant with the most critical preventative measure (fluid intake, 72.6%), compliance rates were low when evaluating associated preventative dietary measures. The "stone clinic effect" and successive role of dietary measures in reducing stone recurrence rates is well-described.¹⁵ A recent meta-analysis highlighted the importance of fluids in reducing stone recurrence, with a risk reduction in stone formation of 60–80%.¹⁶ Unfortunately, less than 10% of high-risk renal stone patients undergo a metabolic evaluation.¹⁷ While fluid intake plays a crucial role in stone prevention, the literature suggests that patients who receive specific dietary recommendations based on a comprehensive evaluation have fewer stone recurrences than those who only received general dietary advice.¹⁸ The majority of our study participants (68.3%) were unaware of their stone composition or predisposing metabolic condition, thereby limiting the efficacy of dietary treatment recommendations.

Renal stones are associated with high morbidity and pose a significant economic burden to any healthcare system.⁵ The rising incidence in associated medical comorbidities, including both obesity and diabetes, is expected to result in an increased stone management cost of \$1.24 billion dollars annually in the U.S. by 2030.¹⁹ Increasing patient awareness and knowledge of preventative stone practices would improve patient outcomes while concurrently reducing healthcare expenditures.

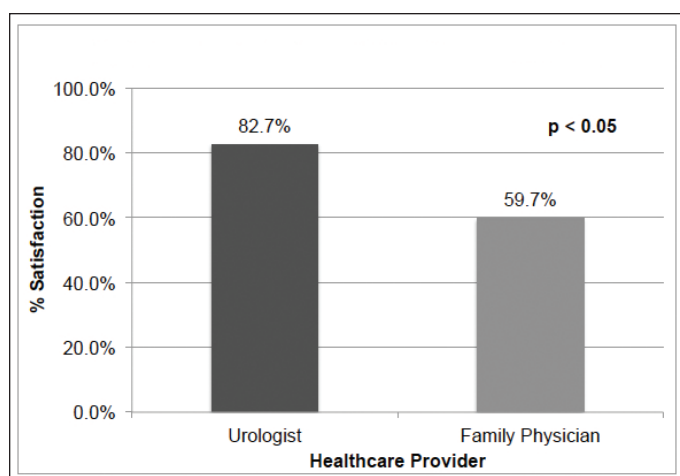


Fig. 1. The association between participant satisfaction and healthcare provider.

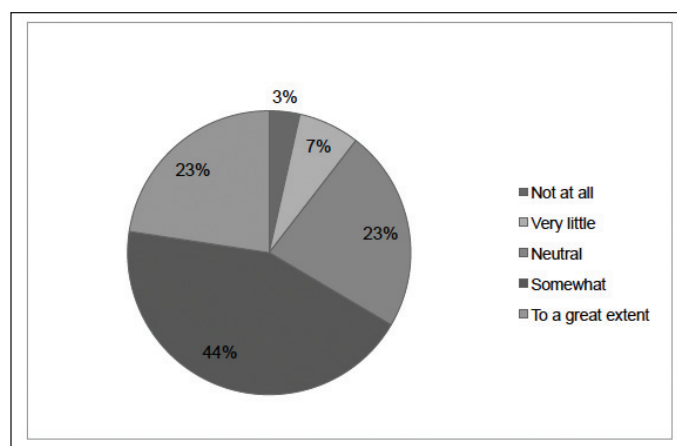


Fig 2. Participant confidence in the value of preventative stone measures.

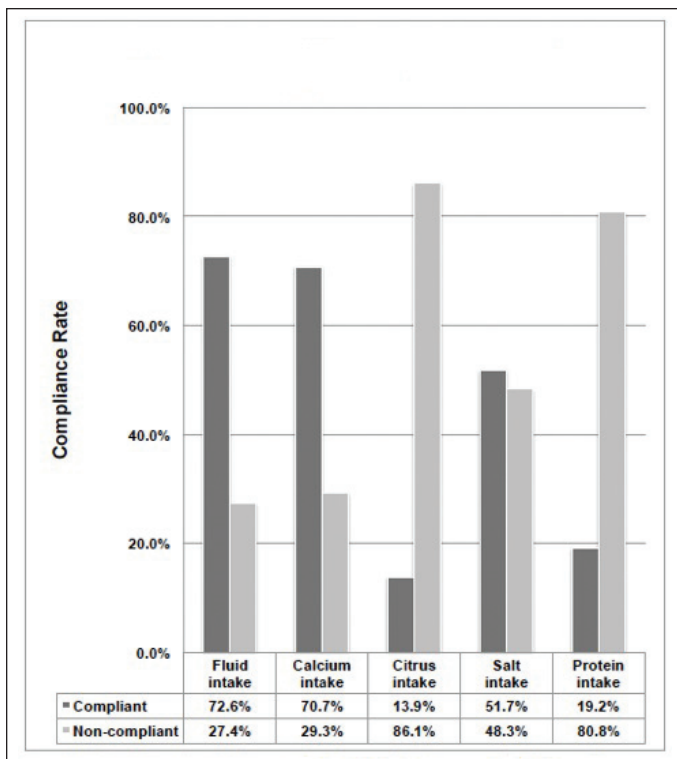


Fig. 3. Participant compliance with preventative practices.

The majority of participants demonstrated confidence in the utility of preventative practices in stone prevention. Despite this confidence, compliance rates were marginal. This discrepancy may be due to a number of factors, such as inadequate knowledge translation, interpersonal relationships, personal or cultural views, and/or lack of perceived disease severity. A patient's health literacy is central to his or her ability to comply. In a large study of over 2500 patients, nearly one-third had marginal or inadequate health literacy, while language barrier was an insignificant factor.²⁰ Many studies confirm these trends and indicate that current interventions aimed at increasing health literacy to improve patient compliance have, to date, been relatively ineffective.²¹ The interpersonal dynamics of the patient-provider relationship play a vital role in determining a wide array of patient outcomes, including patient compliance to treatment recommendations. Patients who perceive satisfactory patient-provider communication while having a physician that empowers them to be active in their own care tend to be more motivated to adhere.²² Patient understanding of their recommendations and a healthy patient-provider relationship is not sufficient to eliminate the possibility of non-compliance, as patients' mindsets strongly influence their compliance. In our study population, less than 25% of participants perceived their disease as severe. If patients embrace opinions that are incongruent with those of their physician, they may have difficulty forming an enthusiasm or intention to be compliant.

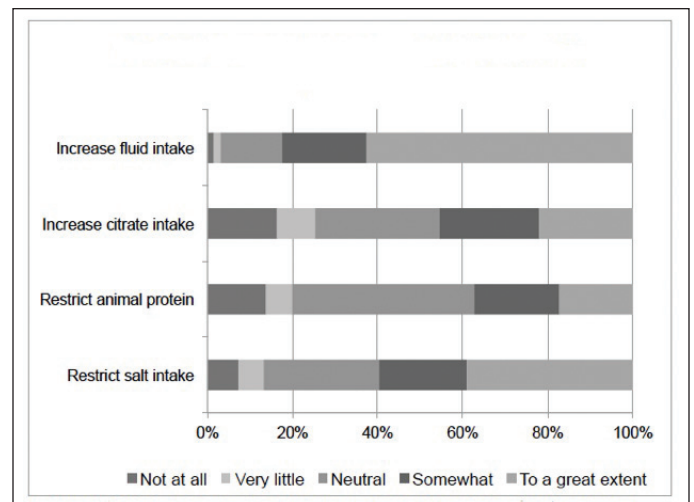


Fig. 4. Participant knowledge of preventative stone practices.

Participants perceived satisfactory knowledge translation more often with their urologist, in contrast to their primary care provider. Based on healthcare provider clinical expertise, this study finding is not unexpected. The importance of visit frequency between patient and specialist and how it positively influences compliance was an intriguing outcome. It has been described that an important factor in non-compliance is patients' inability to remember the details of physician recommendations during clinic visits.^{23,24} Even during clinical encounters where information is communicated effectively and comprehension is initially high, much of what is conveyed is often forgotten within moments of leaving the physician's office.²⁵ Perhaps frequent and effective clinic visits, along with the availability of health promotion literature for the patient, may be a worthwhile consideration during initial stone presentation to optimize preventative stone practices, potentially reducing future patient morbidity.

The limitations of our study deserve mention. It describes a cohort of patients at a single academic institution in Canada, thus potentially limiting its generalizability to other patient populations. By capturing information at one point in time using a cross-sectional design, this study is unable to establish causal relationships between measured variables. Further, recall bias is a notable limitation, as participants may have falsely stated their experience of prior educational encounters. The location of survey dissemination lends to the possibility of outcome bias. To limit bias, all participants completed the survey prior to their clinical encounter. Despite proceedings to circumvent social desirability bias, such as survey anonymity and equitable participant treatment regardless of participation, this bias is inherent. The questionnaire distributed to participants was not validated; however, two practicing urologists with subspecialty training in stone management formally reviewed the survey prior to recruitment. Furthermore, it is unknown whether patients in our study population had previously received written

material regarding kidney stone prevention, and/or had previously searched elsewhere (e.g., internet) for additional information. Following completion of the survey in clinic, patients received CUA kidney stone educational pamphlets. In the future, providing these pamphlets during every stone encounter in clinic can supplement the education received from the patient's urologist, perhaps improving knowledge and compliance to best practice guidelines.

Conclusion

In this single-centre, prospective, cross-sectional survey study, recurrent renal stone formers perceived satisfactory knowledge translation more often with their urologist when compared to their primary care provider; however, overall patient compliance to preventative best practice guidelines was poor. These findings are consistent with the broader medical literature as it pertains to patient compliance, yet adds to the lack of data available within the renal stone patient population. A future larger-scale study may be of value in further understanding potential barriers to knowledge translation and ultimately compliance of the recurrent stone former.

Competing interests: Dr. Shayegan has received grants/honoraria from Abbvie, Astellas, Janssen, and Sanofi; and has participated in clinical trials supported by Astellas and Janssen. The remaining authors report no competing personal or financial interests.

This paper has been peer-reviewed.

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Appendix 1



Assessing the knowledge and practices of the recurrent kidney stone-former

1) Age (years):

- | | |
|----------|----------|
| a. 18-20 | e. 41-50 |
| b. 21-25 | f. 51-60 |
| c. 26-30 | g. 61-70 |
| d. 31-40 | h. 70 + |

2) Sex:

- | | |
|------|------|
| a. F | b. M |
|------|------|

3) What is your highest level of education?

- Did not complete high school
- High school diploma/GED
- Some college
- College graduate (diploma)
- Some university
- University graduate (bachelor's degree)
- Post-graduate school (i.e., master's degree, M.D., Ph.D.)

4) Current medical conditions (if known – please circle all that apply to you):

- Inflammatory bowel disease (Crohn's Disease/ulcerative colitis)
- Hyperparathyroidism
- Medullary sponge kidney
- Adult polycystic kidney disease
- Sarcoidosis
- Type 1 renal tubular acidosis
- Other(s), please specify: _____

5) Do you have a family history of kidney disease (immediate family members)?

- Yes
- No
- Unsure

6) What type of stones do you form (if known)?

- Calcium oxalate
- Calcium phosphate
- Uric acid
- Cystine
- Magnesium ammonium phosphate
- Ammonium acid urate
- Other: _____
- Don't know/unsure
- Comments _____



7) When were you first diagnosed with kidney stone disease (year)? _____

8) Have you ever had surgery and/or shockwave lithotripsy to treat your kidney stones?

- a. Yes
- b. No
- c. If yes, how many times have you had to have your stones surgically removed?

d. Comments _____

9) Approximately how many encounters have you had with each clinician regarding your kidney stones:

- a. Family physician: _____
- b. ER physician: _____
- c. Urologist: _____
- d. Dietician: _____

10) How satisfied are you with the education that you have received about preventing kidney stones? (Please check the box)

	Very Unsatisfied	Unsatisfied	Neutral	Satisfied	Very Satisfied	N/A
Family Physician						
ER Physician						
Dietician						
Urologist						
Other sources						

Specify other sources _____

11) When you see each of the following clinicians, how often do they educate you on the following preventative measures for kidney stones (please check the box)?

<i>Family Physician</i>	Always	Usually	About half the time	Seldom	Never	N/A
Fluid Intake						
Calcium Intake						
Protein Intake						
Citrate Intake						
Oxalate Intake						
Salt Intake						

<i>ER Physician</i>	Always	Usually	About half the time	Seldom	Never	N/A
Fluid Intake						
Calcium Intake						
Protein Intake						
Citrate Intake						
Oxalate Intake						
Salt Intake						



<i>Urologist</i>	Always	Usually	About half the time	Seldom	Never	N/A
Fluid Intake						
Calcium Intake						
Protein Intake						
Citrate Intake						
Oxalate Intake						
Salt intake						

<i>Dietician</i>	Always	Usually	About half the time	Seldom	Never	N/A
Fluid Intake						
Calcium Intake						
Protein Intake						
Citrate Intake						
Oxalate Intake						
Salt Intake						

Comments _____

12) To what extent do the following treatment measures prevent kidney stones?

	Not at all	Very Little	Neutral	Somewhat	To a great extent
High fluid intake					
High calcium intake					
Restricted animal protein diet					
High citrate intake (i.e. lemonade, orange juice)					
Low salt intake					
High oxalate diet (i.e. spinach, nuts, chocolate, tea)					

The following questions are to assess your routine behaviours and the answers should reflect what you do on a daily basis to prevent recurrence of kidney stones:

1. Regarding fluid intake, I:

- a. Restrict fluid intake to less than 1L per day
- b. Drink 1L cranberry juice per day
- c. Drink enough fluid, so that my urine is clear and output is approximately 2-3L per day
- d. Have not changed the amount of liquid that I drink

2. Regarding protein intake, I have:

- a. Increased my total protein intake
- b. Restricted my animal protein intake
- c. Restricted my vegetable protein intake
- d. Not restricted my protein intake

3. **Regarding calcium intake, I have:**
 - a. Restricted my calcium intake
 - b. Maintained a normal calcium intake
 - c. Increased my calcium supplement intake
 - d. Increased my dietary calcium intake

4. **Regarding citrus intake, I have:**
 - a. Restricted my citrus intake
 - b. Maintained my usual citrus intake
 - c. Increased my citrus intake

5. **Regarding salt intake, I have:**
 - a. Increased my salt intake
 - b. Maintained my usual salt intake
 - c. Restricted my salt intake

6. **If you currently take medications to help with kidney stone prevention (i.e. hydrochlorothiazide, allopurinol, and others), I take the medication:**
 - a. Never
 - b. Rarely
 - c. Occasionally
 - d. Frequently
 - e. Always

7. **How would you rate the severity of your kidney stone disease?**
 - a. Not a problem
 - b. Mild problem
 - c. Moderate problem
 - d. Severe problem
 - e. Very severe problem

8. **Do you believe that conservative treatments prevent kidney stones (i.e. diet, medication)?**
 - a. Not at all
 - b. Very little
 - c. Neutral
 - d. Somewhat
 - e. To a great extent

Comments:

Thank you for taking this survey!