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SYMPOSIUM PAPER

Clinical risk index in urolithiasis

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Abstract Various risk indices have been propounded by various authors to assess the severity of stone formation in the human urinary tract. However, most of these indices are laboratory oriented and not feasible to be performed in a hospital setting. Most of these also do not take into consideration all the possible influences on stone formation. In this paper, the correlation of various clinically relevant risk indices has been assessed to understand the relevance of the prediction in the possibility of future stone formation. 500 stone patients were studied to find out the various possible risk factors. The total score of the index was fixed as 100. Forty three variables were used to calculate the index, and each variable was given a score ranging from one to eight. They included the following: age 20–40 (1), sex (2), family history (3), Gulf returned (1), external occupation (1), primary (1), recurrent (5), symptoms (2), RBC (1), PC (1), COD (1), COM (2), UA (2), crystal aggregation (2), urinary infection (1), pH below 6 (1), bilateralism (2), kidney/U/B/U (1), passer (2), multiple organs (2), multiple number (2), incomplete removal (5), serum calcium (3), serum phosphorus (1), serum magnesium (1), serum creatinine (1), serum uric acid (4), urine volume (1), urine specific gravity (1), urine calcium (1), urine phosphorus (1), urine uric acid (5), urine magnesium (2), urine oxalate (8), urine citrate (8), calcium magnesium ratio (2), creatinine clearance (1), tubular reabsorption of phosphate (4), urine calcium oxalate ratio (2), urine oxalate citrate ratio (5), urine oxalate uric acid ratio (2), urine calcium uric acid ratio (2), stone COM/COD (2) and stone UA/cystine (2). After calculating the index, it was correlated with the clinical severity index. The severity status of each patient was considered as +/++/+++/++++ (nil/low/moderate/severe) depending on the status of the disease in long term assessment. In 127 patients, the risk index was calculated after a period of over 1 year to see the change in index score. On calculating the risk index and correlating with the severity grade of the stone disease, the correlation coefficient r value was +0.67 which was significant at $P < 0.001$ level. The risk index could be altered by dietary habit changes, drugs, life style changes, and appropriate drug schedules. The second assessment after 1 year of the 127 patients showed that the mean risk index could be reduced from 43.08 to 36.56. This difference was statistically significant ($P < 0.01$). It is concluded that by using the present clinical risk index assessment, it is possible to arrive at a prediction regarding future stone formation in any individual. It is also possible to reduce the risk of stone formation by dietetic and life style changes and appropriate chemotherapeutic drugs.

Keywords Urinary stone · Risk index · Clinical index · Biochemical index · Risk ratios

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Introduction

Urinary stone formation is ubiquitous. The incidence of stone formation is gradually increasing in the whole universe in recent years. Various therapeutic modalities have

been attempted for treating urinary stone disease and for preventing further stone formation. Clinicians have primarily utilized the various newer instrumental modalities for crushing stones and removing them by extracorporeal shock waves, endoscopically or laparoscopically. Even though much progress has been made in surgical retrieval methods, very little success has been achieved in prevention of further stone formation. It has also not been possible for clinicians to identify the potential stone formers. Herein comes the relevance of identifying risk of further stone formation. It is seen that more than 60% of the patients who form stones for the first time are likely to form stones again in their life time. The recurrence of stone disease may take place within a few months in some patients or after decades in others. The important aspect for the treating clinician is to decide what precautions are to be taken and for how long in each patient in order to prevent further stone formation.

With these requirements in mind, several research workers have propounded various theories and methodologies to identify the risk of stone formation in an individual. Some of the recent innovative ideas of risk factor identification include those of Robertson et al. [1], Ogawa and Hatano [2], and Tiselius [3]. Many clinicians have tried to use the above risk identification models. The practical difficulties in performing most of the above calculations deter clinicians from performing them in a hospital setting. So much so, these assessment factors have not become popular. It is in this context that the present work was performed to decide whether a clinically oriented assessment of the patient will predict stone formation in him.

Materials and methods

The study was undertaken in the urinary stone clinic. The patients with stone problem are classified into stone patients, colic patients and, crystalluria patients. The classification altered based on progress of disease over the years. 500 stone patients were studied to identify the possible risk factors. The maximum score of the index was fixed as 100. Forty three variables were assessed to calculate the index and each variable was given a score ranging from one to eight. After calculating the index, it was correlated with the clinical severity index. The severity status of each patient was considered as +/++/+++/++++ (nil/low/moderate/severe) depending on the status of the disease in long term assessment. In 127 patients, the risk index was calculated after a minimum period of 1 year to see the change in index score (Table 1). The patients studied were classified into stone formers, colic patients and, crystalluria patients. They were advised dietetic and life style changes and prescribed appropriate chemotherapeutic drugs (combination of allopurinol and pyridoxine in various doses—intermittent very low dose prophylaxis/very low dose prophylaxis/low dose prophylaxis/moderate dose prophylaxis/high dose chemotherapy or very high dose chemotherapy). The post treatment assessment of severity status was based on stone retrieval, stone passage, movement down or reduction in size of existing stones. Symptomatic relief, reduction in extent of blood cells, and crystals were also taken into consideration.

Results

Of the 500 patients studied, 132 had radiologically recognized stones. Of these, 18 had stones alone, 40 had stones with colic, 27 had stones with crystalluria, and 47 had stone, colic, and crystalluria. 259 patients had colic, of which 73 had colic alone and 186 had colic with crystalluria. Of the 109 crystalluria patients, 11 had crystalluria without symptoms, and 98 had crystalluria with symptoms excluding colic. On calculating the risk index and correlating with the severity grade of the stone disease, the mean index score was 41.57, and the correlation coefficient r value was +0.67 which was significant at $P < 0.001$ level. Of the total 500 patients studied, 213 were primary stone formers, and the rest were recurrent stone formers. There was no significant difference between the mean score of the primary stone formers (40.97) and the recurrent stone formers (42.02). In the post-treatment evaluation in 127 patients, the risk index was altered by dietary and life style change advice and appropriate drug schedules. Of these, 47 had radiological stones (7 with stone only, 8 with stone and colic, 9 with stone and crystalluria and 23 with stone, colic and crystalluria). 37 were colic patients (8 with colic alone and 29 with colic and crystalluria). Of the 43 crystalluric patients, 5 had no symptoms and 38 had symptoms other than colic. 23 patients (17 of the colic group and 6 of the crystalluria group) among the 127 patients were shifted to stone group following passage of stones during the period of study. The second assessment after 1 year showed that the mean risk index reduced from 43.08 to 36.56. This difference was statistically significant ($P < 0.01$).

Discussion

The utility or otherwise of the various risk indices pertinent to prediction of stone formation have been debated recently [4, 5]. This work was performed as an offshoot to various discussions that had been taking place over the years regarding the identification of risk factors in predicting future stone formation in an individual. Various authors have propagated different risk index calculations in the recent past. A look at each of these risk factor recognition

Table 1 Proforma to assess risk index score

Date:

Name of the patient: Reg. No.

Diagnosis: Age:

Pre date: Post date:

Intervention: IVLDP/VLDP/LDP/MDP/HDC/VHDC/Diet/Chemotherapy + diet

(Intermittent very low dose prophylaxis/very low dose prophylaxis/low dose prophylaxis/moderate dose prophylaxis/high dose chemotherapy or very high dose chemotherapy)

Duration: Years Months Days

Compliance: Total/irregular/stopped

Clinical score pre treatment: Clinical score post treatment:

Post treatment relief: Clinical/retrieved/passed/biochemical/haematuria/crystalluria/nil

No.	Parameter	Variable	Pre tt. score	Post tt. score
1.	Age	20–40	1 0	1 0
2.	Sex	M F	2 1	2 1
3.	Family history	++/+	3 2 0	3 2 0
4.	Gulf	+	1 0	1 0
5.	Occupation	Ext	1 0	1 0
6.	Recurrent/primary		5 1	5 1
7.	Symptoms	++/+	2 1 0	2 1 0
8.	RBC	+	1 0	1 0
9.	PC	++	1 0	1 0
10.	COD	+	1 0	1 0
11.	COM	+	2 0	2 0
12.	UA	+	2 0	2 0
13.	Crystal aggregation	+	2 0	2 0
14.	Urinary infection	+	1 0	1 0
15.	pH below 6		1 0	1 0
16.	Bilateral/unilateral		2 1 0	2 1 0
17.	Kidney/U/ B/U		1 0	1 0
18.	Passer	+	2 1 0	2 1 0
19.	Multiple organ		2 0	2 0
20.	Multiple/single		2 1 0	2 1 0
21.	Incomplete removal	+	5 0	5 0
22.	Serum calcium mg % (>11/10–11/9–10/<9)		3 2 1 0	3 2 1 0
23.	Serum phosphorus mg % (>2.5/<2.5)		1 0	1 0
24.	Serum magnesium mg % (<1.3/>1.3)		1 0	1 0
25.	Serum creatinine mg % (>1.5/<1.5)		1 0	1 0
26.	Serum uric acid mg % (>10/8–10/6–8/<6)		5 2 1 0	5 2 1 0
27.	Urine volume cc (<2000/>2000)		1 0	1 0
28.	Urine specific gravity (>1020/<1020)		1 0	1 0
29.	Urine calcium mg/day (>300/<300)		1 0	1 0
30.	Urine phosphorus mg/day (>2510 /<2510)		1 0	1 0
31.	Urine uric acid mg/day (>800/600–800/400–600/<400)		5 2 1 0	5 2 1 0
32.	Urine magnesium mg/day (<6/>6)		2 0	2 0
33.	Urine oxalate mg/day (>300/100–300/40–100 /<40)		8 5 3 0	8 5 3 0
34.	Urine citrate mg/day (<150/150–300/>300)		8 5 0	8 5 0
35.	Serum calcium magnesium ratio (>8.5/<8.5)		2 0	2 0
36.	Creatinine clearance (<80/>80)		1 0	1 0

Table 1 continued

No.	Parameter	Variable	Pre tt. score	Post tt. score
37.	Tubular reabsorption of phosphate (<80/>80)		4 0	2 0
38.	Urine calcium oxalate ratio (<7.5/7.5–10 />10)		2 1 0	2 1 0
39.	Urine oxalate citrate ratio (>0.25/<0.25)		5 0	5 0
40.	Urine oxalate uric acid ratio (<0.06/0.06–0.16 />.16)		2 1 0	2 1 0
41.	Urine calcium uric acid ratio (<0.5/0.5–0.75 />0.75)		2 1 0	2 1 0
42.	Stone COM/COD/Mix		2 1 0	2 1 0
43.	Stone UA/Cyst/Mix		2 1 0	2 1 0
Total risk for stone formation %			–	–

modalities is necessary to understand the problem faced by clinicians all over the world and to enunciate a format for a foolproof recognition of stone forming propensity.

Robertson et al. [6] mention the saturation inhibition index plus invitro measurement of inhibition of growth and aggregation of calcium oxalate crystals in a metastable solution containing urine. Robertson [7] recognizes the importance of urinary volume, calcium, oxalate, citric acid, uric acid, and magnesium to calculate the PSF values (probability of stone formation). It is very interesting to note their view point that small changes in the values of risk factors within the normal range may significantly alter the risk of the stone formation in any patient. They also found a major overlap in single stone formers and recurrent stone formers. This observation was corroborated in the present study, where the single stone formers and recurrent stone formers did not vary significantly in the total risk score calculated.

Pak and Galosy [8] propagated the urinary formation product ratio—activity product ratio using in-vitro method. The formation product ratio was calculated by adding calcium chloride or sodium oxalate to urine to identify the minimum level of supersaturation for spontaneous nucleation to occur. Activity product ratio was measured by incubating urine calcium oxalate or brushite crystals. The procedure itself shows that it is technically too demanding for routine use in hospitals.

Werness et al. [9] propounded the equil 3 schedule which incorporated parameters like urinary volume, calcium, oxalate, citrate, uric acid, pH and magnesium and to a certain extent sodium, phosphate, sulfate, and potassium. These indices were based on quotients, in-vitro studies, and urine microscopic findings. These risk factor recognition procedures also present difficulties in performing in routine clinical setting. Tiselius [10] stressed upon the calcium magnesium ratio and calcium citrate ratio. Parks and Coe [11] utilized the urinary calcium, oxalate, magnesium and citrate and the activity product indices for calcium oxalate, and calcium phosphate. Tiselius was not very happy about this and he felt that the ratios should also be recognized. Lee et al. [12] believe that single stone formers are similar to recurrent stone formers in the clinical factors like age, sex, urine volume, smoking, wine drinking, family history, stone number, and history of gout. They reported that family history, number of stones, and history of gout correlated with the risk of stone formation. They recognized that the mean scores were higher in recurrent stone formers. However, longer follow-up, longer data bases and inclusion of more variables are needed to validate the clinical use of these scoring systems. Sutton [5] is not happy with any of the indices, which have been described earlier. It is in this context that the present paper was prepared incorporating clinical features, various biochemical factors, their relevant ratios, and presence and extent of crystals in the urine. Daudon et al. [13] have mentioned that study of serial crystalluria and early morning urine is very important to identify the crystalluria index. The present study shows that a combination of all these factors is very essential for the recognition of the urinary stone formation risk in any individual. It is believed that further studies in this direction will be able to identify the most important precipitating factors for stone formation in a potential stone former.

Conclusion

It is concluded that by performing the various clinical and investigative studies, it is possible to arrive at a prediction regarding future stone formation in any individual. It is also possible to reduce the risk of stone formation by dietetic and life style changes and appropriate chemotherapeutic drugs.

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