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Urological Research

The Oxalate-Tolerance-Value: A Whole Urine Method to Discriminate Between Calcium Oxalate-Stoneformers and Others

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Summary. In undiluted urine portions the oxalate-concentration required for precipitation (≙ oxalate-tolerance) can be obtained by titration with sodiumoxalate and turbidimetric detection. The corresponding urinary calcium-concentration was measured and the two values plotted against each other. With regard to a standard-curve (measurements in synthetic urine) different behaviour between urines of stone forming patients and others can be observed.

Key words: Whole urine system, Oxalate-titration, Turbidimetry, Discrimination between stone formers and others, Synthetic urine.

Introduction

The formation of solids in urine is determined by:

1. Thermodynamic

- solubility products of slightly soluble compounds
- ionic strength of the urine
- content of dissolved non ionic urinary compounds
- pH

2. Kinetic

- delay of precipitation by induction period
- prevention of precipitations by urinary inhibitors
- influence of solid formation by crystal nuclei [1–7].

Material and Methods

25 ml of fresh voided undiluted urine were titrated at 37 °C with $Na_2C_2O_4$ at a constant rate of addition, using a motordriven micro-burette and constant agitation. The beginning of the precipitation in urine was detected by turbidimetry using dive photometric cell at 700 nm (Fig. 1). Throughout the experiment the pH was measured [8].

In an aliquot of the same urine portion the total calcium-concentration was determined by FAAS (C_2H_2; N_2O).

The oxalate-concentration required for a detectable precipitation (≙ oxalate-tolerance of the urine) was plotted against the corresponding calcium-concentration.

These data were compared with a standard-curve obtained by analogous titrations of a synthetic urine with varying calcium-concentrations (Fig. 2).

The synthetic urine is comparable with human urine regarding its main constituents [9] but contains no organic macromolecular inhibitors (Table 1).

Investigations showed that in the range of interest (pH 5–7) the standard-curve was largely pH-independent.

The data obtained from each individual urine portion should indicate an eventual stone-forming risk. The region on or below the standard-curve was defined as a zone which favoured stone-forming because the oxalate-tolerance-values were comparable or smaller than those of the synthetic urine without macromolec-

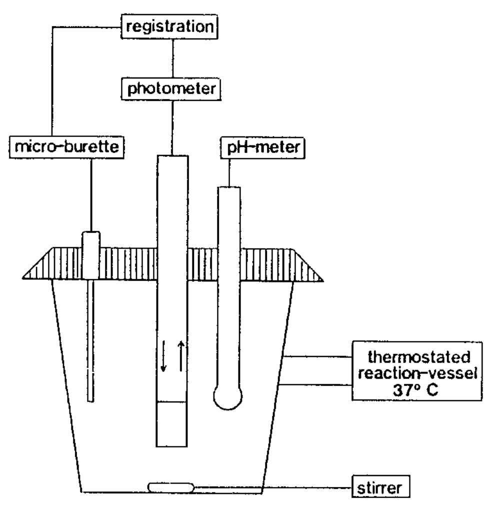

Fig. 1. Measuring equipment

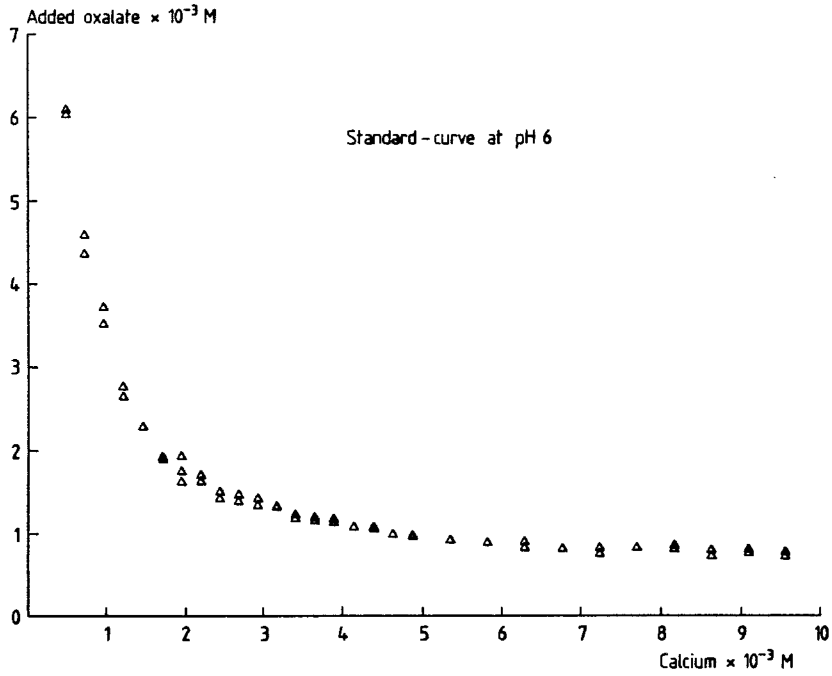

Fig. 2. Standard-curve of a synthetic urine

Table 1. Composition of the synthetic urine

Substance	Grams/liter
NaCl	3.51
$NaHCO_3$	2.27
$NaH_2PO_4 \cdot H_2O$	1.18
K_2SO_4	4.18
NH_4Cl	1.34
$(NH_4)_2$HCitrate	0.41
$MgCl_2 \cdot 6H_2O$	0.67
$CaCl_2 \cdot 2H_2O$	variable
urea	13.7
D-Glucose	0.047
D-Fructose	0.009
Saccharose	0.014
Glycin	0.085
L-Ascorbic acid	0.045

ular inhibitors. The region above the standard-curve was a zone with high oxalate-tolerance-values and therefore carried little risk for stone-formation (Fig. 3).

Results

Urine from patients with primary or recurrent calcium-oxalate stones were investigated just as urines of patients without stones.

The majority of the values from the stone-formers was below the standard-curve and in the critical zone. The valuse from the persons free of stones lie predominantly outside the critical zone. (Table 2).

Table 2. Comparison of the urine datas regarding the standard-curve between oxalate stone-formers and others

	Without risk	At risk	n
Stone-formers	40%	60%	62
Primary	29%	71%	14
Recurrent	44%	56%	48
Others	69%	31%	52

In further experiments the change of the individual daily oxalate-tolerance-values were investigated. All voided urines from four patients over a period of 8 h were measured. Two patients were recurrent stone-formers, one patient was a primary stone-former and the fourth never had stones (Fig. 7).

Discussion

By comparing urine from stone-formers with others a significantly different distribution relative to the standard-curve was observed. The discrimination between urine from stone-formers and other persons can be obtained in most cases by this method. The interpretation of data is complicated by the fact that some of the persons without stones might form stones in the future. The oxalate-tolerance-values of those individuals were according to our definition already in the critical zone. Further investigations will show if such persons have low oxalate-tolerance-values over a

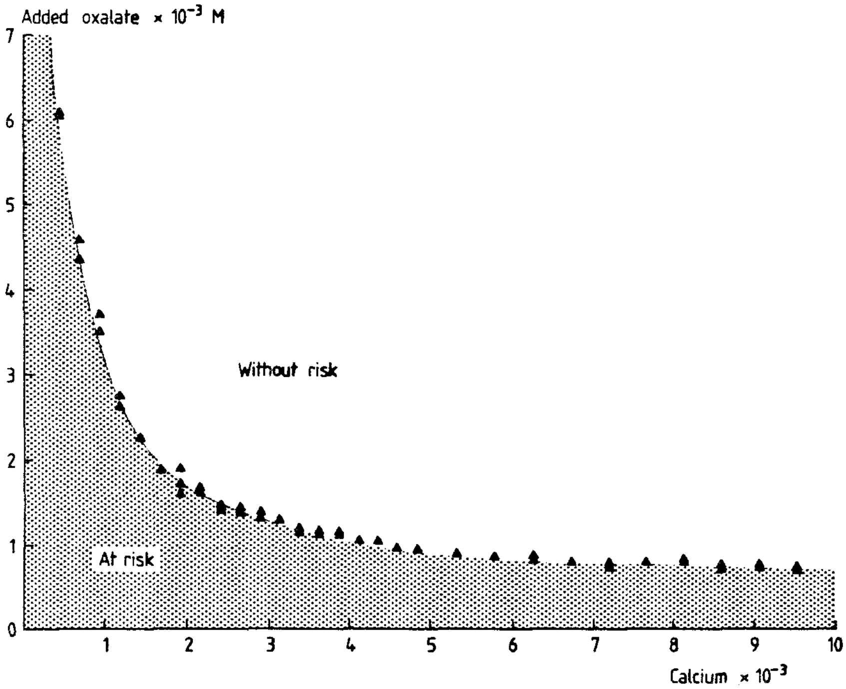

Fig. 3. Definition of zones regarding the standard-curve

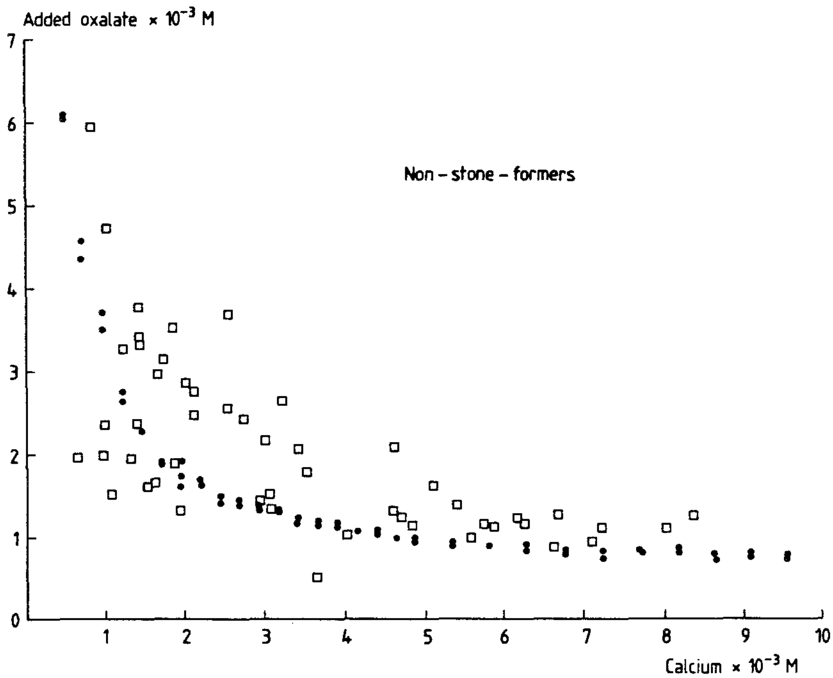

Fig. 4. Distribution of the urine values for non stone-formers

prolonged period. In this case a greater stone-risk or future stone-formation might be possible.

There is a difference between primary and recurrent stone-formers. Most probably the great number of primary stone-formers in the critical zone is due to the fact that many of those patients were hospitalized for renal colic. The data of other stone-formers were obtained in the course of a routine control: in a period free of acute stone problems.

As shown in Fig. 7 the individual daily oxalate-tolerance-values did not vary much over a period of 8 h although the corresponding calcium-concentrations proved different in

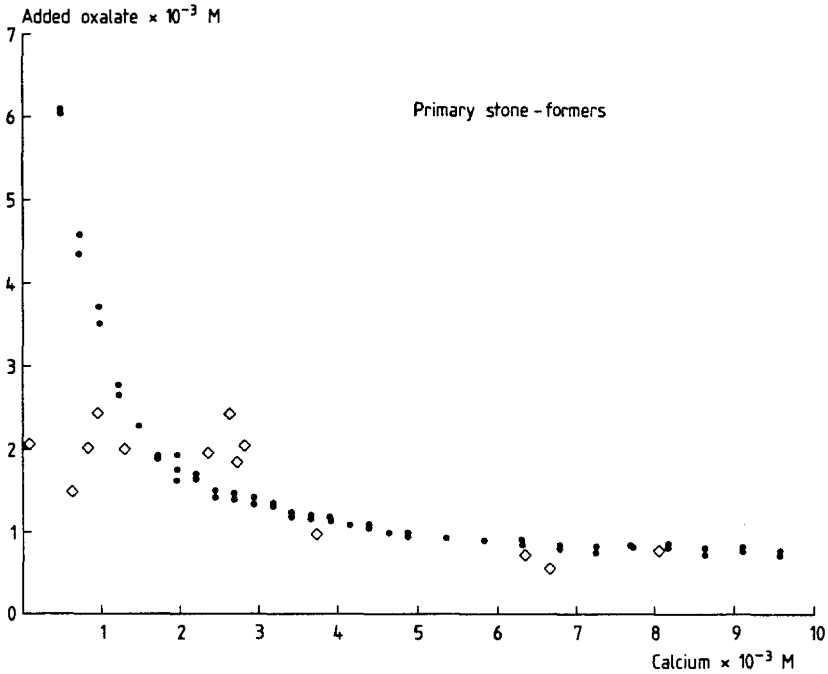

Fig. 5. Distribution of the urine values for primary stone-formers

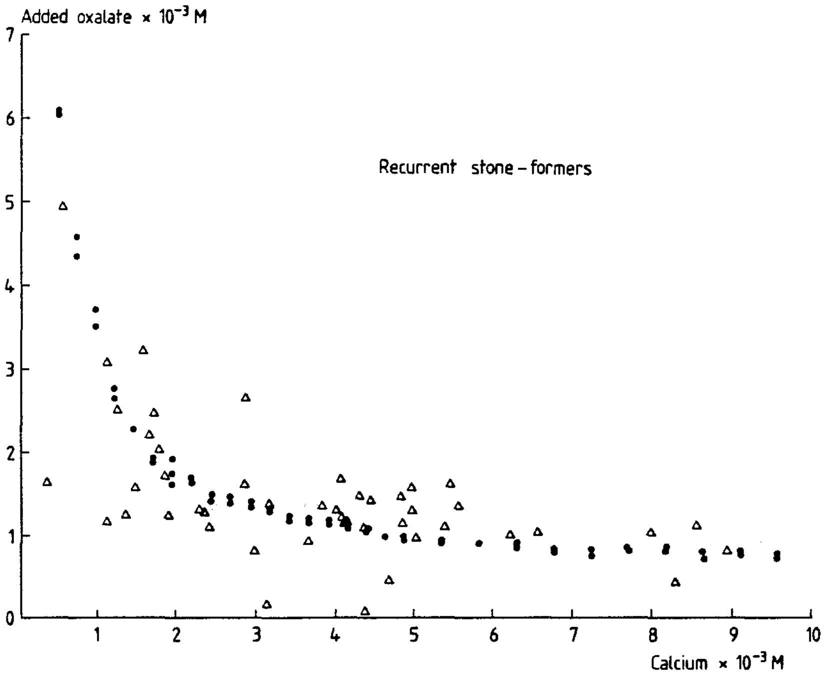

Fig. 6. Distribution of the urine values for recurrent stone-formers

some cases. These effects should be investigated in further experiments with a larger number of patients. Diet and drinking habits influence urinary excretion and might also change oxalate-tolerance. In further studies the influence of known inhibitors on the oxalate-tolerance-value will be investigated.

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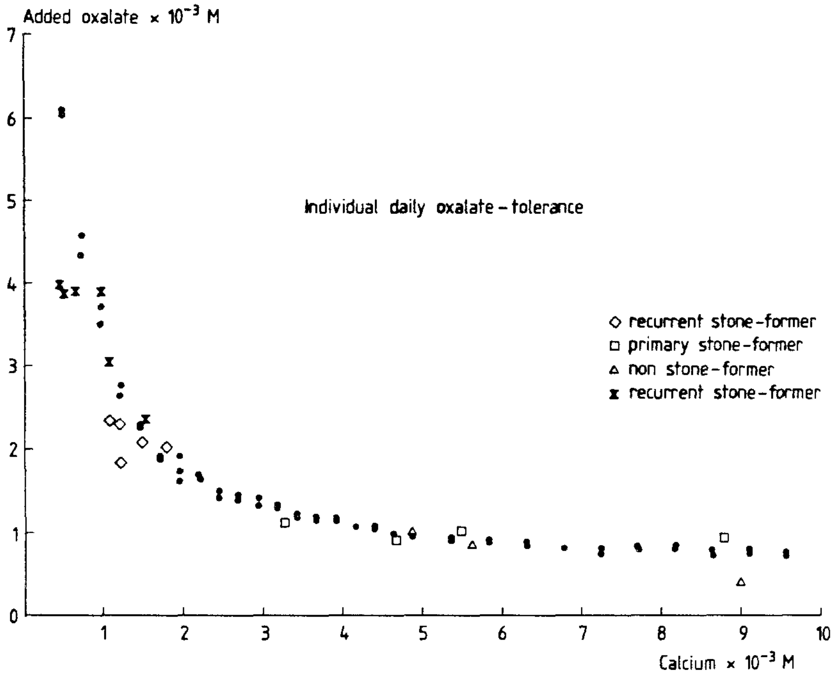

Fig. 7. Individual daily oxalate-tolerance-values (for 4 patients)

References

1. Meyer JL, Smith LH (1975) Growth of calcium oxalate crystals I. Invest Urol 13:31–35
2. Sarig S, Garti N, Azoury R, Wax Y, Perlberg S (1982) A method for discrimination between calcium oxalate kidney stone formers and normals. J Urol 128:645–649
3. Robertson WG, Scurr DS, Bridge CM (1981) Factors influencing the crystallisation of calcium oxalate in urine – critique. J Cryst Growth 53:182–194
4. Meyer JL, Smith LH (1975) Growth of calcium oxalate crystals II. Invest Urol 13:36–39
5. Baumann JM, Wacker M (1980) The direct measurement of inhibitory capacity to crystal growth of calcium oxalate in undiluted urine and in other inhibotor containing solutions. Urol Res 8:171–175
6. Fleisch H (1981) Inhibitors of calcium phosphate precipitation and their role in biological mineralization. J Cryst Growth 53:120–134
7. Will EJ, Bijvoet OLM, Blomen L, van der Linden H (1981) Growth kinetics of calcium oxalate monohydrate. J Cryst Growth 64:297–325
8. Briellmann Th, Seiler H, Hering F, Rutishauser G (1985) The oxalate-tolerance-value: a diagnostic tool for the recognition of stone forming patients, Urolithiasis and related clinical research. Plenum, New York, pp 789–792
9. Wissenschaftliche Tabellen Geigy (1977) 8. Auflage, pp 55–90

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