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Rare non-papillary lithiasis of calcium oxalate monohydrate generated on a central core of potassium urate

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ABSTRACT

This report describes a patient who developed a spheroidal calculus with a central part composed of potassium urate, surrounded by a continuous layer of calcium oxalate monohydrate with crystals of calcium oxalate dihydrate on the surface. The mechanism of calculus development is also suggested.

Introduction

Deposits of sodium and/or potassium urate have been detected in some renal papillary stones of calcium oxalate monohydrate (COM). These urate deposits have been observed in the concave area of the calculus, coinciding with the area in which the Randall Plaques are usually detected. COM crystals begin to grow from this zone, eventually forming the corresponding calculi.

The morpho-compositional study of a calculus is key to understanding its causes. Knowledge of the macro and micro components that form a calculus alone cannot determine the sequence of steps resulting in its formation. Nevertheless, analysis of its morphological aspects is essential, as knowledge of the morphology and composition of a calculus can determine both the causes of and the steps involved in its formation.[1,2]

Although we had examined more than 14,000 stones, we had never detected a non-papillary COM calculus inside a renal infundibulum, in which the center of the calculus consisted of potassium urate, with COM crystals forming around this central core. Moreover, to our knowledge, no similarly structured calculus has been described. This report describes the clinical data of this patient and the morphological characteristics of this unique calculus.

Case presentation

A 22-year-old man with congenital myopathy, who was receiving treatment with mechanical ventilation at home, was admitted for a clinical respiratory infection and respiratory acidosis. His renal function was preserved. He had undergone a gastrostomy, was carrying a No. 22F (7.3 mm) gastric tube, and was being fed through a nasogastric tube, beginning at age 6 months. His diet consisted of oat milk, cereals, and rice, with some chicken. Feeding with fruit was halted due to a skin reaction, but he seemed to tolerate organically grown fruits. His daily fluid intake was 1–1.5 L.

Orthopedic features included myopathic scoliosis, hip dislocation and radial head dislocation. He currently travels in a wheelchair with a gel seat and lifeguard wheels. He has no ulcerations or hygiene problems. Radiologic examination showed scoliosis with triple stable curve. Although the curve is within the range for surgery, this intervention is not being considered as long as the curve remains stable and does not cause problems with sitting or ulcerations.

The patient presented with a urinary pH 6,5, proteinuria, resortive hypercalciuria due to immobilization, hyperuricuria and hematuria before expulsion of the kidney stone. The urinary parameters were determined through 24 h urine collection. The ejected renal calculus consisted of a small spheroidal concretion about 2.5 mm in diameter. Its center consisted of potassium urate (28%), surrounded by a continuous layer of calcium oxalate monohydrate (COM, 71%), with crystals of calcium oxalate dihydrate (COD) on the surface (Fig. 1). The patient passed a mixed uric acid/calcium oxalate monohydrate stone five years earlier.

Morphocompositional analysis of the calculus was performed by scanning electron microscopy coupled to X-ray energy dispersive microanalysis, because it allows the rapid identification of crystalline

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phases and structural aspects of the calculus, fundamental for its study and to establish its etiology.

Discussion

Morphological examination of the calculus showed no area of union with the epithelium, ruling out a papillary origin. This calculus therefore likely developed inside an infundibulum, probably a calix of the lower pole. Because this patient had very low mobility, it was normal for solid particles formed in the urine to be retained in the lower chalices. These solid particles could act as inducers (heterogeneous nucleants) of the formation of the rest of the crystalline mass. This patient had a high urinary pH, high urinary potassium concentration and also high uricuria, factors that favored the crystallization of potassium urate. These crystals, which were retained in the infundibulum, acted as a heterogeneous nucleate of COM, in agreement with findings showing that urates are effective heterogeneous nucleating agents of COM.[3] The presence of COD on the surface of the calculus may have been due to this patient having hypercalciuria, which favors the formation of COD crystals.[4]

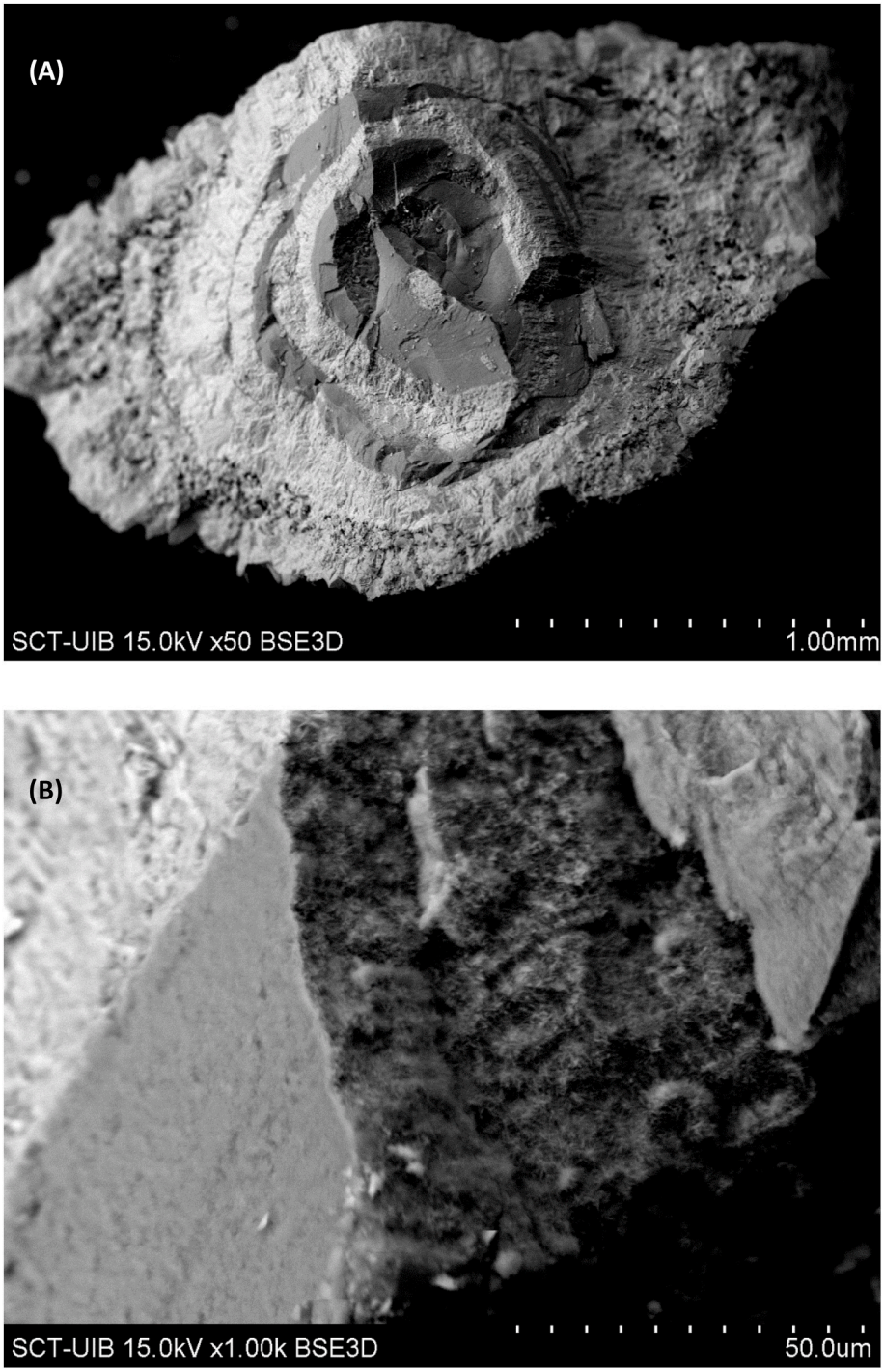

Fig. 1. (A) General view of the calculus section obtained by scanning electron microscopy. The center, dark in color and the layers of the same color intensity correspond to potassium urate. The whitish layers that surround them correspond to calcium oxalate monohydrate. The outer layer is calcium oxalate dihydrate. (B) Detail of the central part. It can be seen that the dark part of potassium urate is constituted by typical fine acicular crystals of this compound.

It is interesting to analyze the fundamental cause of the formation of this very rare renal stone. Based on the etiological factors involved, the patient's urinary pH variations during the day should be assessed. If this patient has high urinary pH for considerable periods of time, acidifying therapies should be attempted. Regardless, a key factor involved in the formation of this calculus was likely the presence of solid particles of potassium urate in his urine. Due to the low mobility of this patient, these particles likely accumulated in lower chalices, inducing the formation of COM. These particles may be eliminated by increasing diuresis and water intake.

Declaration of competing interest

The authors declare no conflict of interest.

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