

Study of renal calculi structure

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There is a type of renal calculi which are build mostly of uric acid. It is currently known that these calculi occur in 13 % of nephrolithiasis cases [1,2]. The macroscopic structure and the average elemental composition of the uric acid stones have been well established [1-3]. Results collected so far showed particularly wide variability of the Ca concentration [4]. The explanation of this observation remains unknown. The investigations concerning the renal calculi growth, their microscopic structure and elemental composition are still conducted.

Uric acid calculi can be divided into two groups. Type I stones develop by crystallization of uric acid from supersaturated solution with respect to uric acid anhydrous (UAA) or uric acid dehydrate (UAD). Their size ranges from several to a dozen or so millimeters. These stones have lamellar structure with small centrally located core composed of the UAA crystals. The layers develop due to variable supersaturation of urine. Thicker layers are formed slowly, when supersaturation and pH are lower, while thinner ones develop quickly, at strong urine supersaturation and high pH.

A characteristic feature of type II stones is the lack of any particular inner structure. Calculi of this type are formed by sedimentation of uric acid crystals that occurs at higher supersaturation of urine.

The pilot study of renal calculi observed in the recurrent nephrolithiasis was performed. To pieces of stones taken from the same patient but in the first and second nephrolithiasis episodes were scanned with the microtomography with the use of synchrotron radiation. The beamline BW2 equipped with microtomographic scanning system was utilized. The energy of 18 keV was applied. Achieved image resolution was about 6 μm . The 3D images of investigated samples were reconstructed.

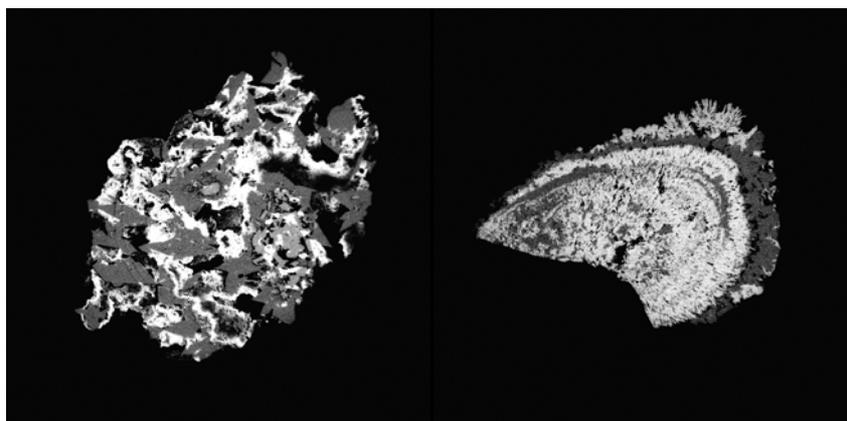


Figure 1: The cross-sections through the reconstructed 3D microtomographic images of two renal calculi samples. The sample collected during the first episode of recurrent nephrolithiasis is shown on the left while the sample cross-section of the second episode is presented on the right. Brighter areas represent regions characterised by higher densities.

The cross-sections through both stone samples are shown in fig. 1. The left-hand-side picture shows the cross-section through the stone collected in the first nephrolithiasis episode while the picture on the right represents the sample collected in the second nephrolithiasis episode. The structure visible inside the first sample suggest that it is of type II stone while the second is of type I calculi.

Our pilot studies led to an interesting conclusion. Calculi formed in the same patient in the first and second nephrolithiasis episodes were usually uric type with similar macroscopic structure and elemental composition. They differ with the inner structure. It is worth to emphasise that two investigated samples came from the same patient but in different nephrolithiasis episodes which suggests different mechanisms of stone development in both phases. The explanation of this fact remains unclear.

References

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