CALCIUM PHOSPHATE RENAL CALCULI: FINE STRUCTURE, COMPOSITION, AND MECHANISM OF FORMATION

FELIX GRASES[1], ANTONIA COSTA–BAUZA[1]*, RAFAEL M. PRIETO[1], ISABEL GOMILA[1], ENRIQUE PIERAS[2], OTAKAR SÖHNEL[3]

[1]Laboratory of Renal Lithiasis Research, University Institute of Health Sciences Research (IUNICS), University of Balearic Islands, Palma de Mallorca, E-07122, Spain
[2]University Hospital Son Dureta, Palma of Mallorca, E-07122, Spain
[3]University of J.E. Purkyne, Faculty of Enviromental Studies, Ustí nad Labem., 400 96, Czech Republic
antonia.costa@uib.es

Chemical composition of non-homogeneous phosphate stones should be related to the conditions prevailing during the formation of each individual part. The object of this communication is to provide detail study of phosphate stone composition on micro- and macro-scale.

Fine inner structure, chemical and phase composition of 10 phosphate calculi from different patients were determined by chemical (wet) analysis, observation by scanning microscope, semi-quantitative determination of Ca, Mg, P and C by energy dispersive X-ray and to X-ray diffraction.

Eight calculi are formed by amorphous calcium phosphate and two by hydroxyapatite. Magnesium was inversely related to Ca/P ratio. Chemical composition of solid phase, in specific areas, varies in wide limits, i.e. composition of calculus interior is highly inhomogeneous on microscale.

All studied calculi contain an abundance of organic matter incorporated in their volume; the content of carbon is a double of the calcium content in molar quantities. Phosphate renal calculi with the low Ca/P molar ratio predominantly consist of amorphous calcium phosphate whereas these with the high Ca/P molar ratio are composed of poorly crystalline hydroxyapatite which can be partially carbonated. Magnesium may be an inhibitor of HAP formation from urine. Abundant organic matter incorporated into calculus volume indicates its decisive role at stone formation. Variable point composition of stones implies widely varying conditions during their development. The following mechanism of phosphate stone formation is considered: organic debris accumulated in kidney cavities serves as a template for formation of a solid phosphatic concretion from supersaturated urine (at urine pH values above 6.2) through heterogeneous nucleation processes.

Keywords: phosphate calculi, structure and composition, etiology