SEDIMENTOLOGICAL AND MINERALOGICAL CHARACTERISTICS OF SOME HUMAN KIDNEY STONES FROM SRI LANKA

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Urinary calculi disease has become a global scourge where it has been recognized as one of the most painful medical problems. Nearly 10 % of the world population is affected by a kidney stone at some point of their lifetime. Primary causative factors for the formation of these stones are not clearly understood, though it has a direct relationship to the composition of urine, which is governed by diet and drinking water. The relation between urolithiasis and hardness of water is considerable, but that has not yet been investigated in detail. However, some chemical parameters, which are available even in trace amounts in urine, may have an indirect influence on the formation of urinary calculi. Effect of such causative factors could be traced by chemical and mineralogical analyses of stone samples. Observations on their internal structure would greatly facilitate in understanding the process of kidney stone mineralization.

68 urinary calculi samples, which were collected from stone removal operations carried out at the General Hospital, Kandy and the Teaching Hospital, Karapitiya (Galle), were analyzed for their elemental concentrations. Na, K, Ca, Mg, Cu, Zn, Pb, Fe and the phosphate content were determined. Structural and mineralogical properties of stones were determined by powder-XRD and FT-IR methods and thin sections were also studied in order to investigate the internal structure. The mean contents of studied elements were 1246 mg/kg (range 249-6837) Na, 284 mg/kg (54.6-1839) K, 279095 mg/kg (1600-461500) Ca, 1384 mg/kg (315-12172); Mg, 14.9 mg/kg (1.9-100) Mn, 227 mg/kg (66.1-1426) Fe, 75.4 mg/kg (21-300) Cu, 504 mg/kg (10.6-8750) Zn, 83.8 (10.1-815) mg/kg Pb, and 354890 mg/kg (4400-4030000) phosphate. Correlation Coefficient analysis were preformed and significant positive correlations were observed between phosphate and Na, K and Mg ($r = 0.77, 0.81, 0.62$, respectively) and between Fe and Pb ($r = + 0.91$). Principal Component Analysis shows that Na, K, Mg and phosphate correlate with one another in the component one, whereas Fe, Cu and Pb correlate with one another in the component two. In the third component one observes positive correlation of Ca and Zn whereas Mn and Cu correlate negatively to Ca and Zn. Among the analyzed components Ca and phosphates are the most abundant ones. However, no positive correlation could be observed between these two components.

The FT-IR and XRD analyses confirm the presence of calcium oxalate monohydrate (whewhellite) as the major crystalline constituent of urinary stones. Microscopic studies of the internal structure reveals nuclei surrounded by alternating dark and light colored bands which make the thicker cortex. These structures are similar to some geological (sedimentary pisoids and oncoids, stromatolites, other coated grains) and biological structures in nature.