Melamine Urinary Bladder Stone

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CASE REPORT

The patient, an 11-month-old girl, was born in Yangjiang, China in the latter half of 2007. The adoptive parents were advised by the Chinese health authorities that the child had ingested melamine-contaminated milk during her stay in the orphanage and recommended an urgent hospital examination. The examination revealed that her renal function and coagulation and serum biochemistry findings were normal. However, the patient presented with acute microcytosis. On ultrasonography, the existence of a vesical lithiasis of 5 × 7 mm without nephrocalcinosis was confirmed. The calculus was mechanically extracted by cystoscopy (using a basket). The patient was discharged from the hospital after 24 hours, with prophylaxis of amoxicillin/clavulanic acid and ibuprofen, without any further complications. All biochemical urinary parameters were normal, but the urinary pH was 5.0. The obtained calculus was studied by Fourier transform infrared (FTIR) spectrometry and scanning electron microscopy, coupled with x-ray microanalysis. Pure solutions of melamine, cyanuric acid, and uric acid were prepared and used to obtain “in vitro” pure and mixed crystals. The “in vitro” obtained crystals were also submitted to analysis by FTIR spectrometry and scanning electron microscopy and x-ray microanalysis. Only the mixed melamine-uric acid crystals obtained “in vitro” exhibited FTIR spectra and scanning electron microscopy features identical to those obtained for the calculus. The FTIR spectrum is considered the fingerprint of a compound (identical FTIR spectra must correspond to the same chemical compound). Therefore, it was concluded without any doubt that the calculus was composed of melamine-uric acid crystals.

COMMENT

It has been recently reported that 4 infants in China have died and at least 53 000 were seriously ill because of consumption of milk powder contaminated with melamine. A dramatic increase in cases of acute renal failure in cats and dogs has been reported and was attributed to the combination of melamine and cyanuric acid in pet food.¹ Thus, melamine seems to be not toxic by itself; however, when it reacts with cyanuric acid, it can cause fatal kidney stones because of the formation of an insoluble melamine cyanurate.² Nevertheless, the problem of melamine in the food chain continues to be discussed and the mechanism whereby melamine, or melamine plus another substance, causes the renal troubles still remains unclear. According to the findings from the bladder calculus presented in our study, its composition corresponded mainly to an insoluble compound formed between melamine and uric acid (Figs. 1 and 2). It is important to emphasize that cyanuric acid was not found in such a calculus. Our “in vitro” studies demonstrated that at acidic urinary pH values (<5.0), melamine and uric acid form an insoluble compound, probably with a structure similar to that of the insoluble compound formed between melamine and cyanuric acid.³,⁴ Nevertheless, according our studies, when uric acid and melamine were mixed in aqueous media at higher pH values (>5.5), no crystals formed. Similar to melamine-cyanuric acid crystals, melamine-uric acid crystals are composed of a hydrogen-bond bimolecular network formed by melamine and neutral uric acid molecules. Melamine is highly soluble in water, and at pH values >5.5, uric acid is in an anionic form.⁵ Consequently, the formation of the mixed insoluble solid would take place only at acidic pH values. In fact, as indicated, the urinary pH of our patient was 5.0.

We believe the presented data permit the use of easy prophylactic measures to avoid the formation of this type of calculi. Thus, alkalinization of urine, for example by citrate administration, could be an easy measure to avoid the formation of insoluble melamine-uric acid crystals. With such alkalinizing measures, it is easy to achieve urinary pH values >6, and, at such pH
values, no insoluble melamine-uric acid crystals will form.

References