Synergistic role of calcium and vitamin D in a murine model of kidney stone disease

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The role of vitamin D in kidney stone formation remains controversial. We analyzed whether long-term exposure of rats to vitamin D supplementation, with or without calcium-rich diet, would promote kidney stone formation or kidney tissue calcifications. Four groups of rats received vitamin D alone (100,000 UI/Kg every 3 weeks), a calcium-enriched diet alone (calcium gluconate 2g/l in drinking water), both vitamin D supplementation and calcium rich diet, or a standard diet (controls) during 6 months. Serum and urine parameters and crystalluria have been monitored during 6 months. Kidney calcifications and stones have been assessed by 3D-micro-computed tomography, μ-Fourier transform infrared spectroscopy, von Kossa staining, and scanning electron microscopy. Although serum calcium levels were similar in the four groups, rats receiving vitamin D had a progressive increase in urine calcium level over the time, especially those receiving both calcium and vitamin D. Calcium alone did not increase significantly urine calcium levels. Most rats receiving calcium and vitamin D had calcium phosphate and to a lesser extent calcium oxalate crystals in urine. At 6 months, rats exposed to calcium or vitamin D alone had a modest and non significant volume of kidney calcifications (mean volume 0.010 and 0.017 mm^3 respectively). By contrast, rats exposed to both calcium and vitamin D supplementation developed significant apatite kidney stones (mean volume 0.121 mm^3). Overall, co-administration of vitamin D and increased calcium intakes exert a synergistic role in kidney stone formation. This original model of murine kidney stone formation raises concerns about the cumulative risk of vitamin D supplementation and high calcium intakes in
humans.