

Post-prandial excretion of calcium is a risk factor for calcium kidney stones

Calcium stones are caused by the precipitation of calcium-oxalate and/or calcium-phosphate on the surface of a kidney papilla. High urinary concentration of lithogenic ions, calcium and oxalate or phosphate, and urine supersaturation with respect to lithogenic salts are necessary to induce precipitation and growth of calcium-oxalate or -phosphate on the papilla and stone formation from these primary deposits (Fig. 1). Idiopathic hypercalciuria is an elevated urinary excretion calcium (greater than 4 mg/kg of body weight) that is not caused by primary hormonal alterations. Patients with idiopathic hypercalciuria may have an increased intestinal absorption of calcium to maintain the balance between calcium entry and exit. Hypercalciuria is detectable in 35-50% of stone formers and is acknowledged as a factor predisposing to kidney stones. However, only a portion of hypercalciuric subjects may develop kidney stones and characteristics distinguishing hypercalciuric stone formers from non-stone formers are unknown. Our study published on the “Clinical Journal of the American Society of Nephrology” searched for these characteristics to explain stone formation in hypercalciuric subjects. The study explored calcium absorption and excretion after an oral load in 172 hypercalciuric stone formers and 36 hypercalciuric subjects without stones by using stable strontium as a surrogate marker for calcium. A standard oral load of strontium chloride was given to patients and strontium measured in blood 30, 60 and 240 min after its ingestion. Strontium excretion was also measured in urine collected during the test (240 min). Because of its duration, the strontium oral load test explored only calcium absorption in duodenum and jejunum that actively absorb calcium ingested with foods.

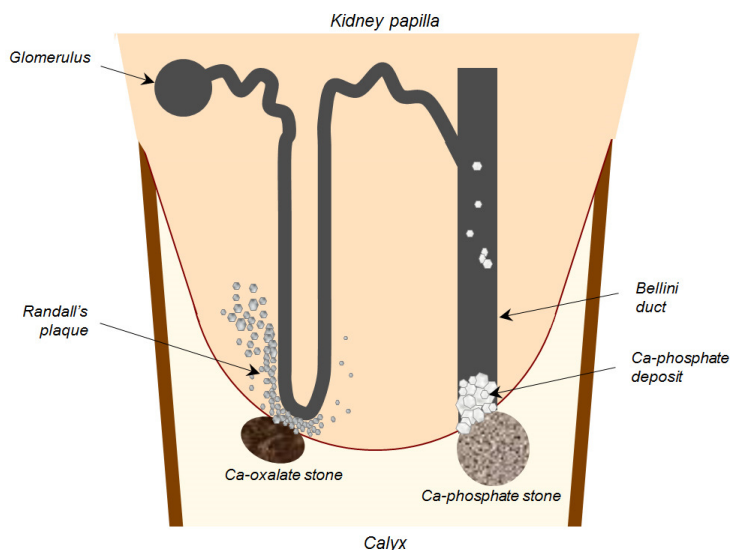


Fig. 1. Kidney papilla and its calyx in the pathogenesis of calcium stones. Kidney stones may develop on the surface of a kidney papilla. Calcium-oxalate stones may form from calcium-oxalate precipitation on interstitial calcium-phosphate deposits (Randall's plaque) reaching the surface of the kidney papilla. Calcium-phosphate stones may form from intratubular calcium-phosphate crystalline deposits located at the tip of the terminal segment of the kidney tubule (Bellini duct).

We observed that hypercalciuric stone formers had higher strontium absorption and excretion than hypercalciuric subjects without kidney stones. Since a significant percentage of hypercalciuric subjects without stones also had low values of bone mineral density (2 standard deviations lower than the mean value in subjects of the same gender and age), we also compared strontium absorption and excretion in hypercalciuric subjects with low or normal bone mineral density. Considering hypercalciuric subjects with low bone mineral density, strontium absorption was confirmed to be higher in stone formers than non-stone formers. Among hypercalciuric subjects with normal bone mineral density, strontium absorption was higher in stone formers, but the difference respect to non-stone formers was not statistically significant. Strontium excretion was not different in hypercalciuric subjects with or without calcium stones considering participants with either normal or low bone mineral density.

The multivariate analysis showed that strontium absorption in the first 30 minutes after ingestion was associated with calcium excretion in hypercalciuric stone formers. In addition, patients with the highest strontium absorption values at 30 minutes (25% of patients having the highest values) had a 5-folded increase of kidney stone risk related to patients with the lowest values of strontium absorption at 30 minutes (25% of patients with the lowest values).

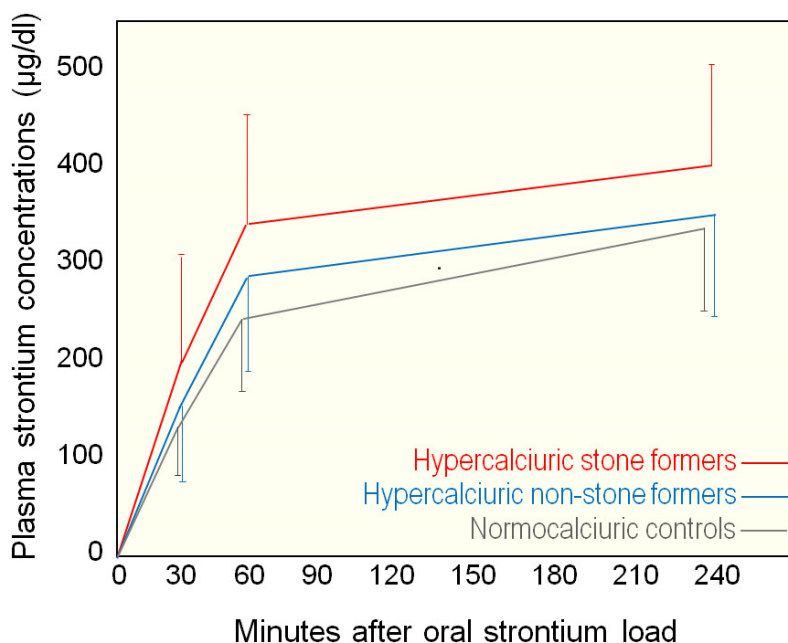


Fig. 2. Strontium absorption in hypercalciuric subjects. Calcium absorption was studied using strontium as a surrogate marker. Strontium absorption was estimated after a strontium-chloride oral load by measuring serum strontium 30, 60 and 240 minutes after its ingestion. The area under the serum strontium-time curve was significantly higher in hypercalciuric stone formers (n=172; men/women: 105/67) than hypercalciuric subjects without stone history (n=36; men/women: 20/16; P=0.02) and normocalciuric controls (n=40; men/women: 24/16; P=0.001) using crude data (F=10.1; P=0.001; ANOVA for repeated measures with Tuckey post hoc test for comparison between groups) and after adjustment for age, sex, and body weight (F=9.9; P=0.001). Strontium absorption was not significantly different between hypercalciuric and normocalciuric subjects without stones.

Findings of our study suggest that a faster calcium absorption could distinguish hypercalciuric stone formers from hypercalciuric subjects not predisposed to stones: an oral calcium load could be followed by early calcium excretion in hypercalciuric stone formers leading to higher calcium concentration in urine and calcium salt precipitation risk. Stone risk could significantly increase during the post-prandial period, when urine may be enriched with phosphate and oxalate in addition to calcium.

In conclusion, our findings suggest that a high calcium absorption and excretion after an oral load could identify hypercalciuric subjects predisposed to stone production.

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Publication

[Intestinal Calcium Absorption among Hypercalciuric Patients with or without Calcium Kidney Stones.](#)

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