Cystinuria Revisited: Presentations with Calcium-Containing Stones Demands Vigilance and Screening in the Stone Clinic

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Abstract

Cystinuria is an inherited disorder resulting in urinary wasting of dibasic amino acids and often the formation of cystine stones. Cystinuria is often complicated by frequently recurring cystine stones which can form staghorn calculi. The clinical features of cystinuria can be extremely variable leading to missed or delayed diagnosis. Indeed, cystinuria may present with “idiopathic” nephrolithiasis and even calcium containing stones and patients presenting with calculi should be screened for this disorder to allow for appropriate medical and surgical management.

Introduction

Cystinuria is an inherited renal disorder resulting in urinary wasting of dibasic amino acids and often the formation of cystine stones. Cystinuria is often complicated by frequently recurring stones, large stones and staghorn calculi, which may result in nephrectomy and renal failure [1]. Cystinuria is caused by mutations in two genes, SLC3A1 and SLC7A9. Cystinuria is often quoted as an autosomal recessive disease, but infact it may be inherited in multiple ways: an autosomal recessive manner, an autosomal dominant manner (where mutations are present in both genes). Within SLC3A1 and SLC7A9, point mutations, multi-exon deletions and duplications and genomic rearrangements have all been described, leading to a loss of function of their encoded proteins. SLC3A1 encodes the accessory protein rBAT [2] whilst SLC7A9 encodes the catalytic transport protein b0,+ AT [3]. Together these proteins form a heterodimer that functions as an amino acid transport system known as system b0,+ an electrogenic exchanger of extracellular dibasic amino acids and cystine for intracellular zwitterionic amino acids [4,5]. Within the kidney, system b0,+ is expressed at the luminal membrane in the renal proximal tubule and mediates reabsorption of cystine, ornithine, lysine and arginine [5].

The clinical features of cystinuria can be extremely variable leading to missed or delayed diagnosis. Clinical variability is mostly seen in patients with heterozygous mutations and a recent study highlights this fact [6]. Here, a genetic screen of 272 renal stone formers and patients with nephrocalcinosis identified 52 likely causative mutations in genes known to lead to monogenic renal stone formation. Surprisingly, within this cohort there were 6 patients in whom known pathogenic rearrangements have all been described, leading to a loss of function of their encoded proteins. SLC3A1 encodes the accessory protein rBAT [2] whilst SLC7A9 encodes the catalytic transport protein b0,+AT [3]. Together these proteins form a heterodimer that functions as an amino acid transport system known as system b0,+ an electrogenic exchanger of extracellular dibasic amino acids and cystine for intracellular zwitterionic amino acids [4,5]. Within the kidney, system b0,+ is expressed at the luminal membrane in the renal proximal tubule and mediates reabsorption of cystine, ornithine, lysine and arginine [5].

Given that there are 2 underlying genes which lead to cystinuria, whose inheritance patterns and biochemical phenotypes are variable, the detection or clinical suspicion of cystinuria should prompt molecular genetic studies. With the advent of next generation sequencing techniques, these studies will become more accessible and will lead to important correlations between genetic variants and disease presentations and long term outcomes. Renal stone patients deserve a precise diagnosis of their cause of calculi as preventive measures can then be tailored towards the underlying cause.

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References