Diagnostic dilemmas in primary hypomagnesaemia - a treatable metabolic disorder in children

Abstract

Primary hypomagnesaemia is a treatable metabolic cause of refractory seizures in children. We report an Indian family with three siblings who presented with refractory seizures during neonatal period. A novel mutation of TRPM6 gene was identified. Early detection and adequate magnesium therapy improved clinical outcome and long term prognosis of probed. Focus of presenting this case report is to convey a vital key message that primary hypomagnesaemia in addition to being a fully treatable metabolic disorder only when intervened early also needs uninterrupted, balanced, lifelong magnesium therapy both as oral diet and drugs supplements to prevent both mortality and morbidity.

Keywords: primary hypomagnesaemia, TRPM6, refractory seizures, neonatal period, clonic spasms, epileptogenic foci

Introduction

Magnesium, an essential cofactor required for normal intracellular metabolic activities related to energy storage and utilization within human biological systems has vital roles through TRPM6 gene in neuronal development and functioning. Hypomagnesaemia defined as serum magnesium levels <1.6 mg/dl or <0.74 mmol/L may be primary due to hereditary causes or secondary to systemic disorders like intestinal malabsorption or polycthemia. We report an Indian family with hereditary hypomagnesaemia and secondary hypocalaemia (HSH) to highlight importance of early diagnosis and timely administration of adequate lifelong magnesium supplements to improve clinical outcome and long term prognosis.

Case report

A 4 years old male child was referred to Pediatric endocrine and metabolic clinic for evaluation of primary etiology of refractory seizures since infancy. During clinical examination child was noted to have florid caries teeth, dysarthria, positive Trousseau sign, weak handgrips, generalized hypotonic and brisk deep tendon reflexes. Salient highlights of past history included the following in that child was born third to second degree consanguineous parents with history of two elder male siblings deaths in infancy due to undiagnosed disorders like intestinal malabsorption or polycthemia. We report an Indian family with hereditary hypomagnesaemia and secondary hypocalaemia (HSH) to highlight importance of early diagnosis and timely administration of adequate lifelong magnesium supplements to improve clinical outcome and long term prognosis.

As child was asymptomatic and neurodevelopment milestones were normal for age, inadvertent omission of calcium and magnesium supplements resulted in recurrence of carp pedal spasms at around 4 years of age. Hence a complete metabolic reevaluation was done. Biochemistry revealed persistent hypocalaemia with total calcium varying from 4.8 to 7mg/dl, ionized calcium low at 0.41mg/dl (normal 4.8 to 5.52 mg/dl) with normal albumin. Magnesium was low varying from 0.4 to 0.9 mg/dl, phosphorus levels were normal to high (normal 4.5 to 6.5mg/dl), 25 hydroxyl vitamin D was low at 21ng/ml (normal above 30ng/ml) with reduced parathormone (PTH) levels at 5pg/ml(normal >32pg/ml) respectively. Serum creatinine levels were normal at 0.3 mg/dL. Fractional excretion of magnesium, sodium, chloride and calcium were 0.3 mEq/l, 180 mEq/l, 65 mEq/l and 35mEq/l respectively (normal spot urine magnesium >2mEq/l, sodium <40mEq/l, chloride <40mEq/l, calcium< 3mEq/l).

Pedigree analysis with consanguinity and similar history of refractory seizures in all three male siblings suggested familial disorder with autosomal recessive inheritance. Persistent serum magnesium levels below 0.4 mg/dl with renal fractional excretion of magnesium more than 4% and abnormal urinary concentrations of sodium, chloride and calcium were suggestive of primary renal magnesium wasting in the index child and which could have also been cause of refractory seizures in two other elder siblings. A novel mutation of TRPM6 gene pathiology was considered. Till date around 48 pathogenic TRPM6
mutations have been published. Molecular analysis of transitional receptor potential TRPM6 gene confirmed a large deletion in TRPM6 gene which encodes transient receptor potential cation channel subfamily melastatin 6, a bifunctional protein with both channel and kinase activity regulating entry and balance of magnesium ions in membranes of distal convoluted tubules of kidneys, large intestine, lungs and testes.

<table>
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<th>Test dates</th>
<th>Ca++ in Serum/Urine S/U</th>
<th>Mg+ in Serum/Urine S/U</th>
<th>PTH values</th>
<th>Vitamin D3</th>
<th>Urine Ca/Urinary Creatinine</th>
<th>FE Mg %</th>
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</table>

Abbreviations: S/U-, Serum/Urine; Ca+, Calcium; ICa++, Ionised Calcium; Mg++, Magnesium; [All Measurements as mg/dl]; PTH, Parathyroid hormone [pg/ml]; Vit D3 25[OH]D, [ug/ml]; U Ca/ UCr, Urinary Calcium/Urinary Creatinine; FE Mg%, Fractional Excretion of Magnesium in urine.

Discussion

Primary hypomagnesemia with secondary hypocalcaemia is a rare autosomal recessive disorder characterized by profound hypomagnesemia associated with hypocalcaemia. Path physiology is related to impaired intestinal absorption of magnesium accompanied by renal magnesium wasting as a result of a reabsorption defect in distal convoluted tubule and increased renal clearance of magnesium. Magnesium metabolic derangements particularly hypomagnesemia affect predominantly neuromuscular and cardiovascular system and ventricular arrhythmias are most life threatening. Common signs are usually sudden jerks; carp pedal spasms, muscle cramps and refractory seizures. Both hyper and hypo magnesemia states can impair parathormone (PTH) secretion which also causes secondary hypocalcaemia.

In this child TRPM6 gene mutation possibly caused a frame shift and premature truncation of the protein. It was also noted that child had persistent diarrhea as a significant side effect of oral magnesium therapy which may have added to inadequate intestinal absorption further compromising magnesium levels and recurrence of carp pedal spasms. After stabilization of acute phase follow up advice was prescribed specifically to provide daily magnesium requirements up to 350 mg/day both as drugs and diet to prevent diarrhea with a target to maintain serum magnesium above 1.2 mEq/l. Magnesium tablets were started in a sustained release form to provide daily dosage of 120 to 140 mg/day at 5 mg to 9.6mg/kg/day with oral magnesium rich diet formulated to provide 200 to 220 mg /day along with calcitriol as a source of vitamin D at 40 ng/kg/day and oral calcium supplements at 50 to 75 mg/kg/day respectively. We have followed patient for 5 years and presently child is seizure free with appropriate growth and development.

Conclusion

Our report is presented to emphasize the fact that primary hypomagnesemia is a treatable metabolic disorder requiring high index of suspicion and timely management is vital to prevent mortality and intellectual disability. Carefully balanced magnesium intake as uninterrupted lifelong therapy is most vital to improve both outcome and long term prognosis.

References
