New Recessive Mutations in SYT2 Causing Severe Presynaptic Congenital Myasthenic Syndromes

**Objective** To report the identification of 2 new homozygous recessive mutations in the synaptotagmin 2 (SYT2) gene as the genetic cause of severe and early presynaptic forms of congenital myasthenic syndromes (CMSs).

**Methods** Next-generation sequencing identified new homozygous intronic and frameshift mutations in the SYT2 gene as a likely cause of presynaptic CMS. We describe the clinical and electromyographic patient phenotypes, perform ex vivo splicing analyses to characterize the effect of the intronic mutation on exon splicing, and analyze the functional impact of this variation at the neuromuscular junction (NMJ).

**Results** The 2 infants presented a similar clinical phenotype evoking first a congenital myopathy characterized by muscle weakness and hypotonia. Next-generation sequencing allowed to the identification of 1 homozygous intronic mutation c.465+1G>A in patient 1 and another homozygous frameshift mutation c.328_331dup in patient 2, located respectively in the 5’ splice donor site of SYT2 intron 4 and in exon 3. Functional studies of the intronic mutation validated the abolition of the splice donor site of exon 4 leading to its skipping. In-frame skipping of exon 4 that encodes part of the C2A calcium-binding domain of SYT2 is associated with a loss-of-function effect resulting in a decrease of neurotransmitter release and severe presynaptic and postsynaptic NMJ defects.

**Conclusions** This study identifies new homozygous recessive SYT2 mutations as the underlying cause of severe and early presynaptic form of CMS expanding the genetic spectrum of recessive SYT2-related CMS associated with defects in neurotransmitter release.

Genotype-Phenotype Correlations in Patients With de Novo KCNQ2 Pathogenic Variants

**Objective** Early identification of de novo KCNQ2 variants in patients with epilepsy raises prognostic issues toward optimal management. We analyzed the clinical and genetic information from a cohort of patients with de novo KCNQ2 pathogenic variants to dissect genotype-phenotype correlations.

**Methods** Patients with de novo KCNQ2 pathogenic variants were identified from Italy, Denmark, and Belgium. Atomic resolution Kv7.2 structures were also generated using homology modeling to map the variants.

**Results** We included 34 patients with a mean age of 4.7 years. Median seizure onset was 2 days, mainly with focal seizures with autonomic signs. Twenty-two patients (65%) were seizure free at the mean age of 1.2 years. More than half of the patients (17/32) displayed severe/profound intellectual disability; however, 4 (13%) of them had a normal cognitive outcome.

A total of 28 de novo pathogenic variants were identified, most missense (25/28), and clustered in conserved regions of the protein; 6 variants recurrent and 7 were novel. We did not identify a relationship between variant position and seizure offset or cognitive outcome in patients harboring missense variants. Besides, recurrent variants were associated with overlapping epilepsy features but also variable evolution regarding the intellectual outcome.

**Conclusions** We highlight the complexity of variant interpretation to assess the impact of a class of de novo KCNQ2 mutations. Genetic modifiers could be implicated, but the study paradigms to successfully address the impact of each single mutation need to be developed.
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