Brugada Syndrome Panel

Panel Gene List: *ABCC9, CACNA1C, CACNB2, GPD1L, KCND3, KCNE3, KCNJ8, PKP2, SCN10A, SCN1B, SCN2B, SCN3B, SCN5A, TRPM4*

Additional genes from our cardiology test menu may be added to this panel by selecting test code 481C.

Clinical Features:

Brugada syndrome (BrS) is a genetic heart disorder due to abnormal ion channel function characterized by ST segment elevation on ECG (leads V1-3) in the absence of structural heart disease.[1-3] It is associated with increased risk for syncope, ventricular tachyarrhythmia and sudden cardiac death. In individuals with an apparently normal heart, Brugada syndrome accounts for up to 20% of unexpected sudden deaths and is suspected to account for 4-12% of all unexpected sudden deaths.[4] Brugada syndrome occurs worldwide and is estimated to affect 5 per 10,000 individuals of all ethnicities, with some regional differences.[3]

The diagnosis of BrS is based on clinical history, ECG findings, and family history. Typically, the disorder manifests in patients between ages 20 to 40, but symptoms have been reported from infancy through late life. Most individuals with BrS are asymptomatic. The most common clinical symptoms are syncope and cardiac arrest that occur at rest, during sleep, or with high fever. In some patients, symptoms of BrS will develop after taking certain medications such as sodium channel blockers. Sudden cardiac death may occur without preceding symptoms and without an identifiable cause at autopsy. Additionally, many symptoms of BrS are similar to those of other heart conditions, such as arrhythmogenic right ventricular cardiomyopathy (ARVC), atypical right bundle branch block, left ventricular hypertrophy, early repolarization, acute myocardial infarction, and acute pericarditis.

Inheritance Pattern/Genetics: Autosomal Dominant

Test Methods:

Using genomic DNA from the submitted specimen, the coding regions and splice junctions of the 14 genes (except for exon 6 in *PKP2* and only exons 1-44 in *CACNA1C*) are enriched using a proprietary targeted capture system developed by GeneDx. These targeted regions are sequenced simultaneously by massively parallel (NextGen) sequencing on an Illumina platform with paired-end reads. Bi-directional sequence is assembled, aligned to reference gene sequences based on human genome build GRCh37/UCSC hg19, and analyzed for sequence variants. Capillary sequencing is used to confirm all potentially pathogenic variants and to obtain sequence for regions where fewer than 15 reads are achieved by NextGen sequencing. Concurrent deletion/duplication testing is performed for the genes in the panel using exon-level oligo array CGH (ExonArrayDx). *SCN1B* has gene level resolution; exon level events may not be detected. Data analysis is performed using gene-specific filtering. Probe sequences and locations are based on human genome build GRCh37/UCSC hg19. The array is designed to detect most intragenic

deletions and duplications. Confirmation of copy number changes is performed by MLPA, qPCR, or repeat array CGH analysis. Sequence and array CGH alterations are reported according to the Human Genome Variation Society (HGVS) or International System for Human Cytogenetic Nomenclature (ISCN) guidelines, respectively. Benign and likely benign variants, if present, are not included in this report but are available upon request.

Test Sensitivity:

The clinical sensitivity of sequencing and deletion/duplication analysis of the 14 genes included in the BrS Panel depends in part on the patient's clinical phenotype and family history. In general, the sensitivity is highest for individuals with clearly defined BrS and a family history of disease. The technical sensitivity of the sequencing test is estimated to be 98%. The sequencing panel will not reliably detect deletions, insertions, or rearrangements greater than or equal to five base pairs (bp). Deletions or duplications of less than 500 bp are not reliably detected by array CGH.

Gene	Protein	Inheritance	Disease Association(s)
ABCC9	ATP-BINDING CASSETTE, SUBFAMILY C, MEMBER 9	AD	DCM, BrS, ERS, Cantu syndrome and related disorders
CACNA1C	CALCIUM CHANNEL, VOLTAGE-DEPENDENT, L TYPE, ALPHA-1C SUBUNIT	AD	BrS, Timothy syndrome, LQTS
CACNB2	CALCIUM CHANNEL, VOLTAGE-DEPENDENT, BETA-2 SUBUNIT	AD	BrS
GPD1L	GLYCEROL-3-PHOSPHATE DEHYDROGENASE 1-LIKE	AD	BrS
KCND3	POTASSIUM CHANNEL, VOLTAGE-GATED, SHAL-RELATED SUBFAMILY, MEMBER 3	AD	BrS, SIDS, Spinocerebellar ataxia
KCNE3	POTASSIUM CHANNEL, VOLTAGE-GATED, ISK-RELATED SUBFAMILY, MEMBER 3	AD	BrS
KCNJ8	POTASSIUM CHANNEL, INWARDLY RECTIFYING, SUBFAMILY J, MEMBER 8	AD	BrS, VF, SIDS, Cantu syndrome
PKP2	PLAKOPHILIN 2	AD	ARVC, BrS
SCN1B	SODIUM CHANNEL, VOLTAGE-GATED, TYPE I, BETA SUBUNIT	AD	BrS, CCD, Epilepsy
SCN2B	SODIUM CHANNEL, VOLTAGE-GATED, TYPE II, BETA SUBUNIT	AD	BrS, AF
SCN3B	SODIUM CHANNEL, VOLTAGE-GATED, TYPE III, BETA SUBUNIT	AD	BrS, AF, VF, SIDS
SCN5A	SODIUM CHANNEL, VOLTAGE-GATED, TYPE V, ALPHA SUBUNIT	AD, AR	BrS, DCM, ARVC, HB, LQTS, SSS, SIDS
SCN10A	SODIUM CHANNEL, VOLTAGE-GATED, TYPE X, ALPHA SUBUNIT	AD	BrS, LQTS, AF, painful small-fiber peripheral neuropathy
TRPM4	TRANSIENT RECEPTOR POTENTIAL CATION CHANNEL, SUBFAMILY M, MEMBER 4	AD	HB, BrS

Abbreviations: AD – Autosomal dominant; AF – Atrial fibrillation; ARVC- Arrhythmogenic right ventricular cardiomyopathy; BrS – Brugada syndrome; CCD – Cardiac conduction defect; DCM – Dilated cardiomyopathy; ERS – Early repolarization syndrome; HB – Heart block; LQTS – Long QT syndrome; SIDS – Sudden infant death syndrome; SSS – Sick sinus syndrome; SUDS – Sudden unexpected death syndrome; VF – Ventricular fibrillation

References:

1. Brugada R, Campuzano O, Brugada P, et al. Brugada Syndrome. 2005 Mar 31 [Updated 2014 Apr 10]. In: Pagon RA, Adam MP, Ardinger HH, et al., editors. GeneReviews [Internet]. Seattle (WA): University of Washington, Seattle; 1993-2014. Available from: http://www.ncbi.nlm.nih.gov/books/NBK1517/'
2. Hedley et al. (2009) Human Mutation 30 (9):1256-66 (PMID: 19606473)

3. Fowler et al. (2009) Current Opinion In Cardiology 24 (1):74-81 (PMID: 19102039)
4. Antzelevitch et al. (2002) Circ. Res. 91 (12):1114-8 (PMID: 12480811)