Title: Malignant Hyperthermia Susceptibility *GeneReview* Table 5

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Note: The following information is provided by the authors and has not been reviewed by *GeneReviews* staff.

Table 5. Mutations in *RYR1* Associated with MHS

#	Mutation	Exon	Phenotype	Reference
1	F12fsX105	1	CCD, MMD	Monnier et al [2008]
2	L13R	1	MHS/cores	Ibarra et al [2006]
3	L13V	1	CCD, MMD	Monnier et al [2006]
4	C35R	2	MHS	Lynch et al [1997]
5	R44C	2	MHS	Tammaro et al [2003]
6	R44H	2	MHS	Robinson et al [2006]
7	D60N	3	MHS	Robinson et al [2006]
8	S71Y	3	MHS, CCD	Galli et al [2006]
9	R109W	4	CCD	Zhow et al [2007]
10	Q155K	6	MHS	Robinson et al [2006]
11	R156K	6	MHS	Galli et al [2006]
12	E160G	6	MHS, CCD	Shepherd et al [2004]
13	R163C	6	MHS, CCD	Quane et al [1993]
14	R163L	6	MHS	Monnier et al [2005]
15	G165R	6	MHS	Monnier et al [2005]
16	D166N	6	MHS	Rueffert et al [2002]
17	D166G	6	MHS	Robinson et al [2006]
18	R177C	6	MHS	Monnier et al [2005]
19	Y178C	6	MHS	Monnier et al [2005]
20	G215E	8/17	CCD*	Romero et al [2003]
21	V218I	8	MHS	Robinson et al [2006]
22	M226K	8	MHS	Robinson et al [2006]
23	D227V	8	MHS	Monnier et al [2005]
24	G248R	9	MHS	Gillard et al [1992]
25	R316L	10	MHS	Robinson et al [2006]
26	R328W	11	MHS	Loke et al [2003]
27	G341R	11	MHS	Quane et al [1994b]
28	R367L	11	MHS	Robinson et al [2006]

#	Mutation	Exon	Phenotype	Reference
28	R367Q	11	MHS	Galli et al [2006]
29	R401C	12	MHS	Davis et al [2002] , Galli et al [2002]
30	R401G	12	MHS	Robinson et al [2006]
31	R401H	12	MHS	Rueffert et al [2002]
32	R401S	12	MHS	Monnier et al [2005]
33	M402T	12	CCD	Zhou et al [2007]
34	I403M	12	CCD	Quane et al [1993]
35	S427L	13	CCD	Wu et al [2006]
36	Q474H	13	MHS, CCD	Ogata et al [2001]
37	E512K	14	CCD	Wu et al [2006]
38	Y522C	14	MHS	Yeh et al [2005]
39	Y522S	14	MHS, CCD	Quane et al [1994a]
40	R530H	15	MHS	Robinson et al [2006]
41	R533C	15	MHS	Tammaro et al [2003]
42	R533H	15	MHS	Brandt et al [1999]
43	R552W	15	MHS	Keating et al [1997]
44	H581fsX29	16	CCD, MMD	Monnier et al [2008]
45	R614C	17	MHS	Gillard et al [1991]
46	R614L	17	MHS	Quane et al [1997]
47	R819X	20	CCD, MMD	Monnier et al [2008]
48	R1043C	24	MHS	Robinson et al [2006]
49	R1140C	26	MHS	Robinson et al [2006]
50	S1342G	28	MHS	Robinson et al [2006]
51	P1592L	33	MHS	Robinson et al [2006]
52	R1645fsX52	33	CCD, MMD	Monnier et al [2008]
52	G1704S	34	CCD, MMD	Monnier et al [2008]
53	S1728F	34	MHS	Sambuughin et al [2005]
54	S1728P	34	MHS	Ibarra et al [2006]
55	M1729R	34	MHS	Robinson et al [2006]
56	M1814L	34	MHS	Robinson et al [2006]
57	A1832G	34	MHS	Monnier et al [2000]
58	5938del	36	CCD, MMD	Monnier et al [2008]
59	M2101L	39	MHS	Tammaro et al [2003]
60	V2117L	39	MHS	Tammaro et al [2003]

#	Mutation	Exon	Phenotype	Reference
61	D2129E	39	MHS	Rueffert et al [2002]
62	R2163C	39	MHS	Manning et al [1998b]
63	R2163H	39	MHS, CCD	Manning et al [1998b]
64	R2163P	39	MHS	Fortunato et al [2000]
65	V2168M	39	MHS	Manning et al [1998b]
66	I2182F	39	MHS	Wehner et al [2003]
67	A2200V	40	MHS	Sambuughin et al [2005]
68	T2206M	40	MHS	Manning et al [1998b]
69	T2206R	40	MHS	Brandt et al [1999]
70	V2210F	40	MHS	Sambuughin et al [2005]
71	V2212A	40	MHS	Robinson et al [2006]
72	V2214I	40	MHS	Sambuughin et al [2001c]
73	V2280I	42	MHS	Galli et al [2002]
74	N2283H	42	CCD	Zhou et al [2007]
75	I2321V	43	MHS	Robinson et al [2006]
76	R2336H	43	MHS	Robinson et al [2006]
77	R2336Q	43	MHS	Galli et al [2006]
78	N2342S	43	MHS	Wehner et al [2004]
79	E2344D	44	MHS	Monnier et al [2005]
80	V2346M	44	MHS/CCD	Shepherd et al [2004]
81	2347del	44	MHS	Sambuughin et al [2001a]
82	E2348G	44	MHS	Shepherd et al [2004]
83	A2350T	44	MHS	Sambuughin et al [2001b]
84	R2355W	44	MHS	McWilliams et al [2002]
85	E2362G	44	MHS	Galli et al [2006]
86	F2364V	44	MHS	Robinson et al [2006]
87	P2366R	44	MHS	Ibarra et al [2006]
88	A2367T	44	MHS	Sambuughin et al [2001c]
89	G2375A	44	MHS	Wehner et al [2003]
90	A2321P	45	CCD, MMD	Monnier et al [2006]
91	M2423K	45	CCD	Zhou et al [2007]
92	A2428T	45	MHS	Rueffert et al [2002]
93	D2431N	45	MHS	Sambuughin et al [2001c]
94	D2431Y	45	MHS	Robinson et al [2006]

#	Mutation	Exon	Phenotype	Reference
95	G2434R	45	MHS	Keating et al [1994]
96	R2435H	45	MHS, CCD	Zhang et al [1993]
97	R2435L	45	MHS, CCD	Barone et al [1999]
98	A2436V	45	MHS	Galli et al [2006]
99	A2437V	45	MHS	Sei et al [2004]
100	E2439D	45	MHS	Galli et al [2006]
101	c7324-1	Intron 45	CCD, MMD	Monnier et al [2008]
102	R2452Q	46	MHS	Ibarra et al [2006]
103	R2452W	46	MHS	Chamley et al [2000]
104	I2453T	46	MHS, CCD	Rueffert et al [2004]
105	R2454C	46	MHS	Brandt et al [1999]
106	R2454H	46	MHS	Barone et al [1999]
107	R2458C	46	MHS	Manning et al [1998a]
108	R2458H	46	MHS	Manning et al [1998a]
109	P2496L	47	MHS	Ibarra et al [2006]
110	R2508C	47	MHS/CCD	Ibarra et al [2006]
111	R2508G	47	MHS/CCD	Ibarra et al [2006]
112	R2508H	47	MHS/CCD	Ibarra et al [2006]
113	Y2510H	48	MHS	Robinson et al [2006]
114	Q2545D	48	MHS/CCD	Ibarra et al [2006]
115	E2545D	48	CCD	Wu et al [2006]
116	R2591G	48	MHS	Galli et al [2006]
117	T2596I	48	MHS	Robinson et al [2006]
118	V2627L	49	MHS	Galli et al [2006]
119	R2676W	50/53	MHS/CCD/MmD	Guis et al [2004], Robinson et al [2006]
120	D2730G	51	MHS	Ibarra et al [2006]
121	D2730H	51	MHS	Robinson et al [2006]
122	G2733D	51	MHS	Sambuughin et al [2005]
123	E2764K	52	MHS	Galli et al [2006]
124	T2787S	53	MHS/cores	Robinson et al [2006]
125	R2840W	54	MHS	Ibarra et al [2006]
126	L2867G	55	MHS	Galli et al [2006]
127	E2880K	56	MHS	Robinson et al [2006]
128	R2939K	57	CCD	Zhou et al [2007]

#	Mutation	Exon	Phenotype	Reference
129	E3104K	63	MHS	Robinson et al [2006]
130	R3119H	63	MHS/cores	Ibarra et al [2006]
131	R3350H	67	MHS	Sambuughin et al [2005]
132	K3367R	67	MHS/CCD	Ibarra et al [2006]
133	S3448F	68	CCD	Zhou et al [2007]
135	c10348-6	Intron 68	CCD, MMD	Monnier et al [2008]
136	P3527S	71	CCD, MmD*	Ferreiro & Fardeau [2002]
137	E3584Q	72	MHS	Davis et al [1999]
138	L3606P	73	CCD	Wu et al [2006]
139	R3707L	76	MHS	Ibarra et al [2006]
140	Q3756E	79	MHS	Oyamada et al [2002]
141	R3772Q	79	CCD, MMD	Monnier et al [2008]
142	V3840I	82	MHS	Ibarra et al [2006]
143	R3903Q	85	MHS	Galli et al [2006]
144	I3916M	85	MHS	Monnier et al [2002]
145	D3986E	87	MHS	Robinson et al [2006]
146	G3990V	87	MHS	Robinson et al [2006]
147	R4041W	89	MHS	Galli et al [2006]
148	S4050Y	89	MHS	Robinson et al [2006]
149	T4081M	89	MHS	Ibarra et al [2006]
150	S4112L	90	CCD	Jungbluth [2007]
151	N4119Y	90	MHS	Sambuughin et al [2005]
152	R4136S	90	MHS	Galli et al [2002]
153	I4138T	90	MHS	Robinson et al [2006]
154	12801insCG	90	CCD, MMD	Monnier et al [2008]
155	4214-4216del	91	CCD	Monnier et al [2001]
156	V4234L	91	MHS	Galli et al [2002]
157	E4283V	91	MHS	Ibarra et al [2006]
158	A4329D	91	CCD	Zhou et al [2007]
159	R4558Q	94	CCD	Kossugue et al [2007]
160	L4568P	94	CCD	Wu et al [2006]
161	Y4631N	95	CCD	Wu et al [2006]
162	E4634K	95	CCD	Wu et al [2006]
163	T4637A	95	MHS, CCD, NM	Scacheri et al [2000]

#	Mutation	Exon	Phenotype	Reference
164	G4638S	95	CCD	Wu et al [2006]
165	T4637I	95	MHS, CCD, NM	Davis et al [2003]
166	G4638D	95	CCD	Davis et al [2003]
167	R4645Q	95	MHS	Ibarra et al [2006]
168	4647-4648del	95	CCD	Monnier et al [2001]
169	L4650P	95	CCD*	Romero et al [2003]
170	H4651P	95	CCD	Davis et al [2003]
171	L4665P	95	CCD	Zhou et al [2007]
172	P4668S	96	MHS	Oyamada et al [2002]
173	F4684S	96	MHS	Monnier et al [2005]
174	T4709M	96	CCD	Zhou et al [2006]
175	K4724Q	96	CCD	Romero et al [2003]
176	Y4733D	98	MHS	Sambuughin et al [2005]
177	G4734E	98	MHS	Robinson et al [2006]
178	R4737W	98	MHS	Galli et al [2002]
179	R4737Q	98	MHS	Monnier et al [2005]
180	L4793P	100	CCD	Monnier et al [2001]
181	Y4796C	100	MHS, CCD, NM	Monnier et al [2000]
182	F4808N	100	CCD	Davis et al [2003]
183	L4814F	100	CCD	Shepherd et al [2004]
184	I4817F	100	MHS	Robinson et al [2006]
185	G4820W	100	MHS	Robinson et al [2006]
186	L4824P	100	MHS, CCD	Shepherd et al [2004]
187	R4825C	100	CCD	Monnier et al [2001]
188	R4825P	100	CCD	Robinson et al [2006]
189	T4826I	100	MHS	Brown et al [2000]
190	H4833Y	100	MHS	Anderson et al [2008]
191	R4837fsX4839	101	MHS	Rossi et al [2007]
192	L4838V	101	MHS	Oyamada et al [2002]
193	V4842M	101	CCD, MMD	Monnier et al [2008]
194	A4846V	101	CCD	Kossugue et al [2007]
195	V4849I	101	MHS, CCD, MmD*	Jungbluth et al [2002]
196	A4856G	101	MHS	Robinson et al [2006]
197	N4858D	101	CCD	Wu et al [2006]

#	Mutation	Exon	Phenotype	Reference
198	4860del	101	CCD	Monnier et al [2001]
199	F4860V	101	CCD	Robinson et al [2006]
200	R4861C	101	CCD	Davis et al [2003], Wu et al [2006]
201	R4861H	101	CCD	Monnier et al [2001]
202	4863-4869del	101	CCD	Zorzato et al [2003]
203	Y4864C	101	CCD	Sewry et al [2002]
204	K4876R	101	MHS	Sambuughin et al [2005]
205	M4880T	101	MHS	Sambuughin et al [2005]
206	14646+2.99kb	Intron	CCD, MmD*	Monnier et al [2003]
207	C4883X	102	CCD	Zhou et al [2007]
208	G4891R	102	CCD	Tilgen et al [2001]
209	R4893Q	102	CCD	Davis et al [2003]
210	R4893W	102	MHS, CCD	Monnier et al [2001]
211	R4893P	102	CCD	Wu et al [2006]
212	A4894T	102	MHS/cores	Robinson et al [2006]
213	A4894V	102	CCD	Robinson et al [2006]
214	G4897V	102	CCD	Kossugue et al [2007]
215	I4898T	102	CCD, MHS?	Lynch et al [1999]
216	G4899E	102	CCD	Monnier et al [2001]
217	G4899R	102	CCD	Tilgen et al [2001]
219	A4906V	102	CCD	Tilgen et al [2001]
220	R4914G	102	CCD	Monnier et al [2001]
221	R4914T	102	CCD	Davis et al [2003]
222	N4920N	102	CCD	Wu et al [2006]
223	F4921S	102	CCD	Davis et al [2003]
224	F4921T	102	CCD	Wu et al [2006]
225	4927-4928del	102	CCD	Davis et al [2003]
226	V4927F	102	CCD	Davis et al [2003]
227	I4938M	103	MHS, CCD	Shepherd et al [2004]
228	D4939E	103	MHS, CCD	Shepherd et al [2004]
229	A4940T	103	CCD	Sewry et al [2002]
230	G4942V	103	MHS	Galli et al [2002]
240	F4960Y	104	MHS/cores	Robinson et al [2006]
241	P4973L	104	MHS	Monnier et al [2002], Galli

#	Mutation	Exon	Phenotype	Reference
				et al [2002]
242	4976X	104	MMD	Jungbluth [2007]

Residues are numbered according to the human ryanodine receptor sequence (NM_000540.2 and NP_000531.2). A * denotes recessive inheritance. MH susceptibility has not been tested for many of the C-terminal mutations that result in clinically expressed CCD.

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