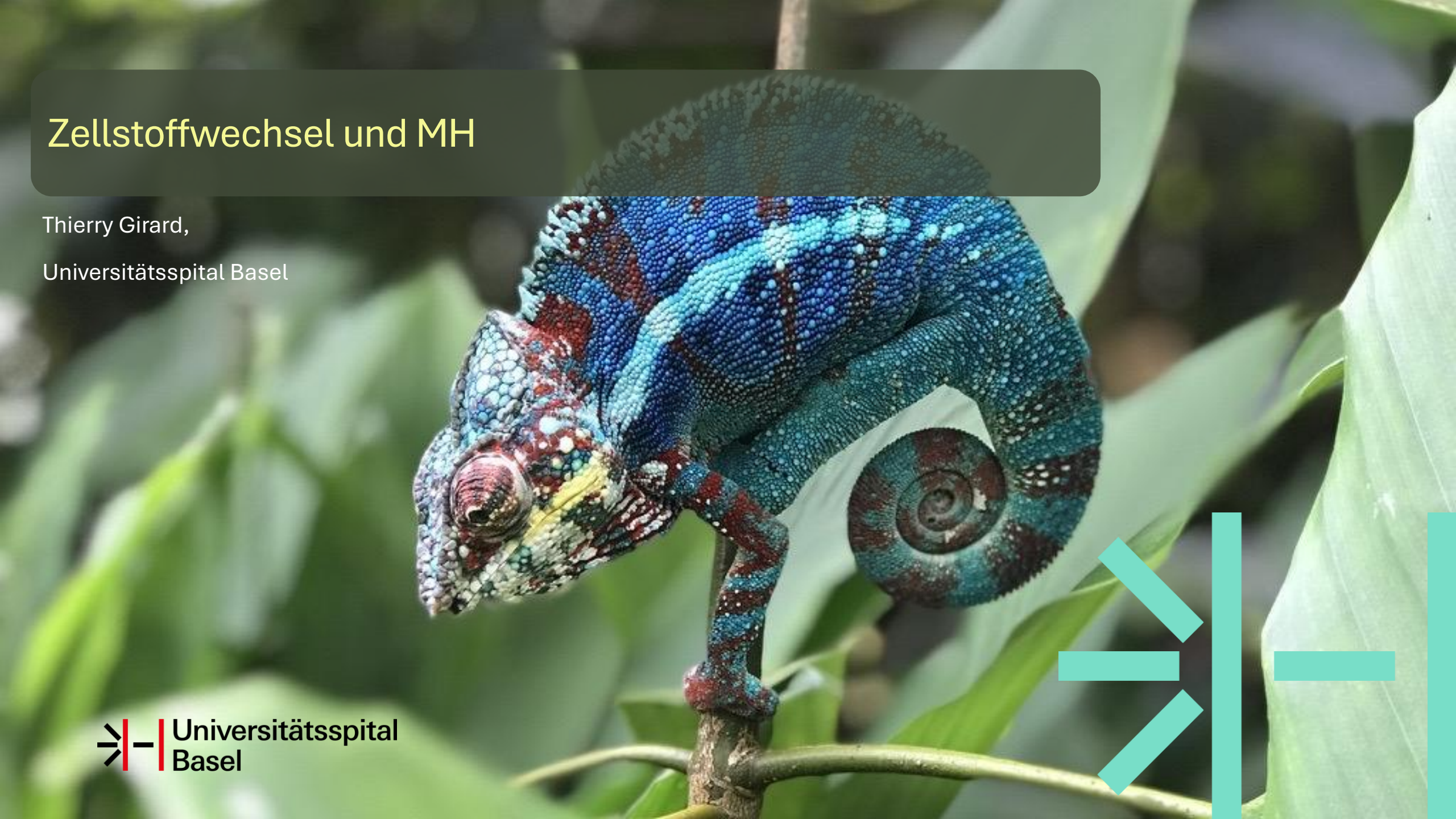
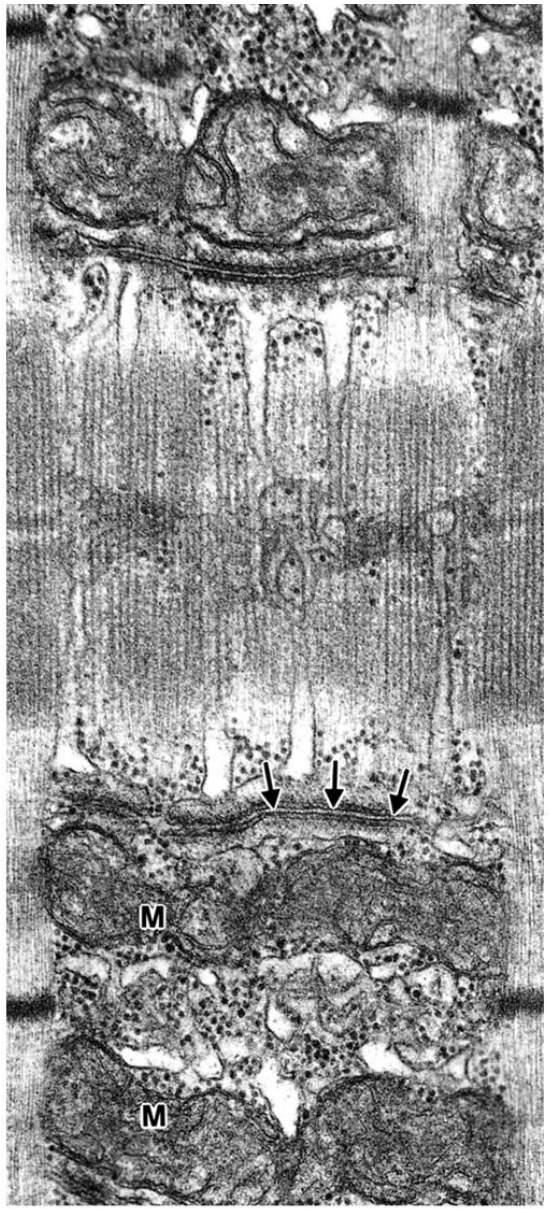
Zellstoffwechsel und MH

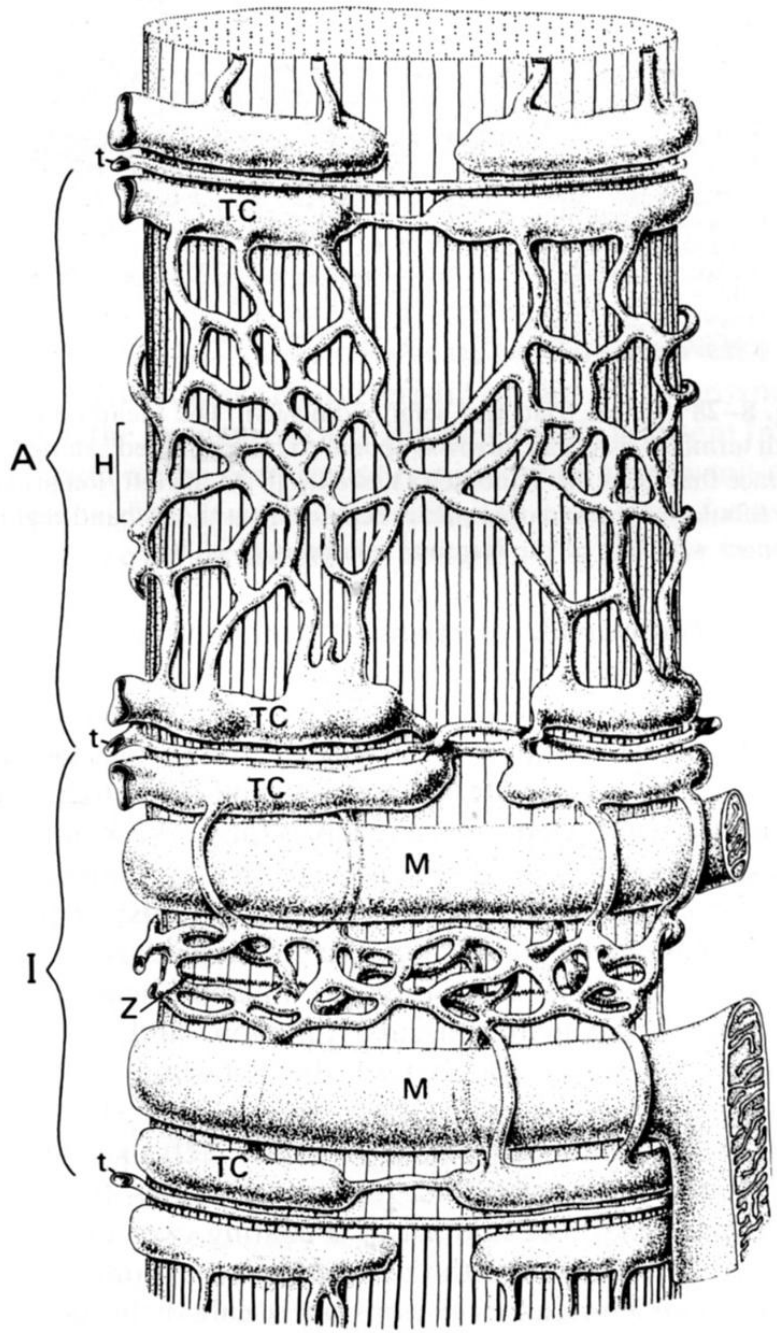
Thierry Girard,

Universitätsspital Basel

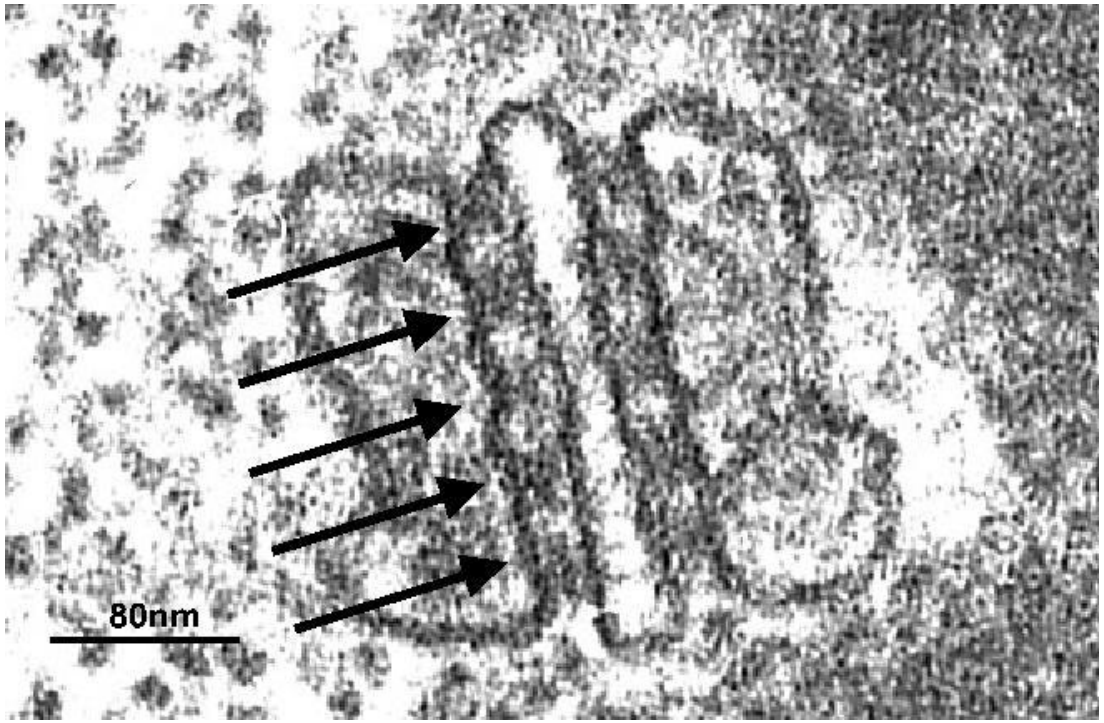


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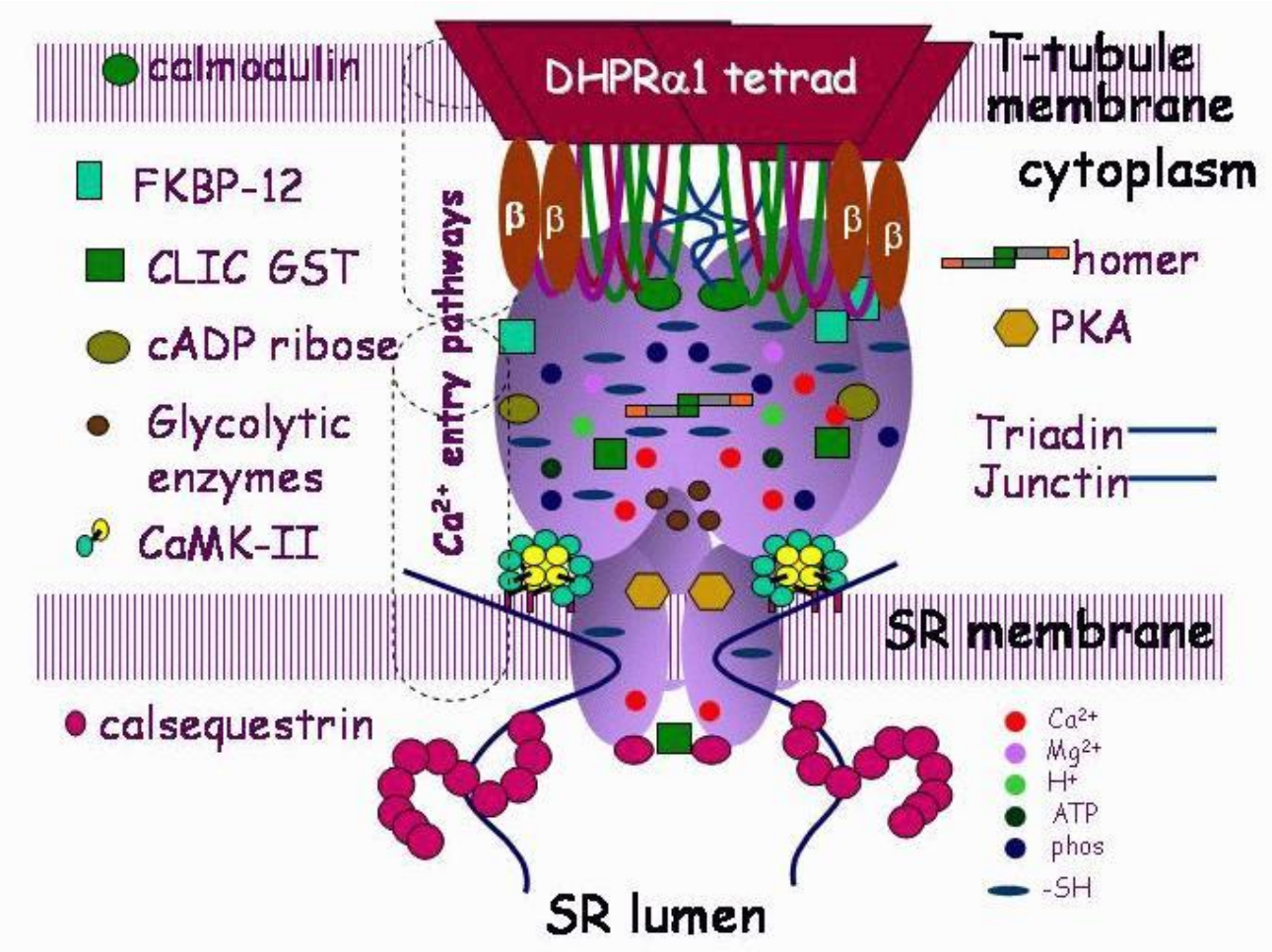

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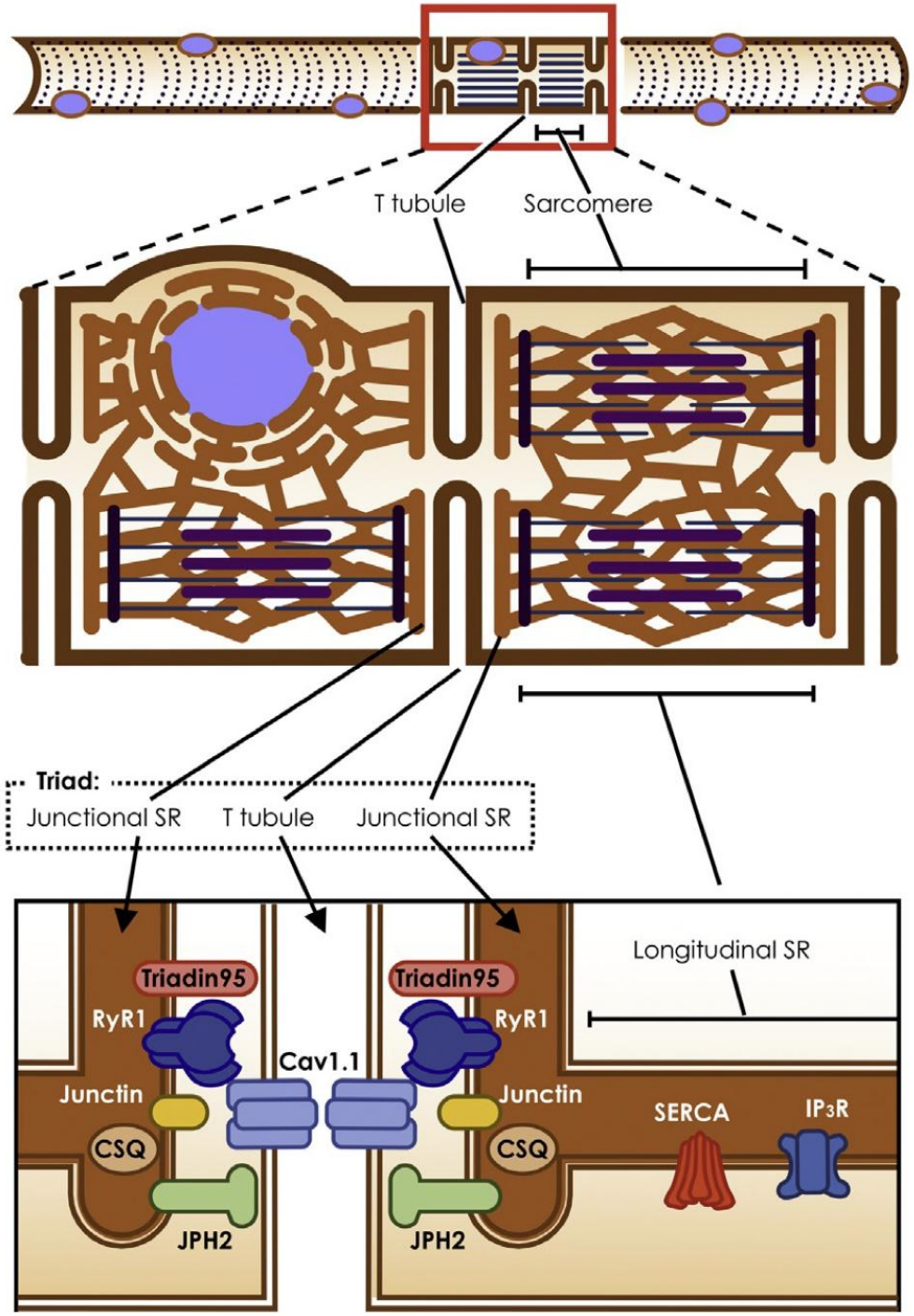

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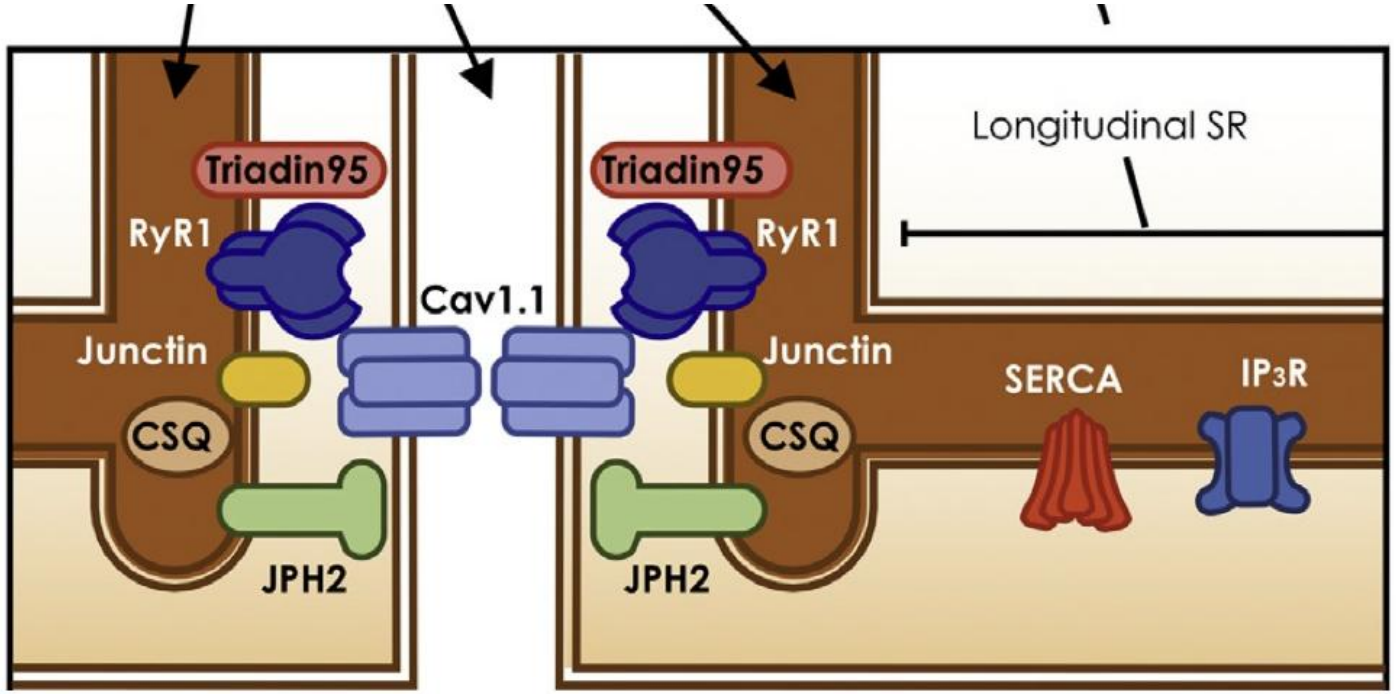
1960


80nm

2000


calmodulin
DHPRα1 tetrad
T-tubule membrane
cytoplasm
FKBP-12
CLIC GST
cADP ribose
Glycolytic enzymes
CaMK-II
Ca2+ entry pathways
β β β β
homer
PKA
Triadin
Junctin
SR membrane
calsequestrin
Ca2+
Mg2+
H+
ATP
phos
-SH
SR lumen





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1. Détection de variant·s ponctuel·s (SNV) pathogène·s ou probablement pathogène·s:

Gène	RefSeq	Coordonnées (v. GRCh37; hg19)	Nucléotide	Acide aminé	Type	Zygosité	Classe
RYR1	MANE_Select-NM_000540.3	chr19:38'943'464	**c.1250T>C**	**p.Leu417Pro**	Faux sens	Hétérozygote	**Pathogène**
RYR1	MANE_Select-NM_000540.3	chr19:38'957'030_38'957'052	**c.3170_3178+14del**	**p.?**	Perte du site d'épissage	Hétérozygote	**Pathogène**

Statut de porteur des parents

Mère: ID 37653

Gène	RefSeq	Coordonnées (v. GRCh37; hg19)	Nucléotide	Acide aminé	Statut
RYR1	MANE_Select-NM_000540.3	chr19:38'943'464	c.1250T>C	p.Leu417Pro	Ne porte pas le variant
RYR1	MANE_Select-NM_000540.3	**chr19:38'957'030_38'957'052**	**c.3170_3178+14del**	**p.?**	**Porte le variant en hétérozygotie**

Père: ID 37652

Gène	RefSeq	Coordonnées (v. GRCh37; hg19)	Nucléotide	Acide aminé	Statut
RYR1	MANE_Select-NM_000540.3	**chr19:38'943'464**	**c.1250T>C**	**p.Leu417Pro**	**Porte le variant en hétérozygotie**
RYR1	MANE_Select-NM_000540.3	chr19:38'957'030_38'957'052	c.3170_3178+14del	p.?	Ne porte pas le variant

Freitag Abend – letzter Patient des Programms ist MH positiv: Was ist korrekt?

- Halogenierte volatile Anästhetika vermeiden
- Lachgas vermeiden
- Neostigmin vermeiden
- Respirator mit 10 l/min für 10 Minuten spülen
- Prämedikation mit oralem Dantrolen 2h präoperativ
- Operation absagen

British Journal of Anaesthesia, 131 (1): 5–8 (2023)
doi: 10.1016/j.bja.2023.04.014
Advance Access Publication Date: 15 May 2023
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What is malignant hyperthermia susceptibility?

Philip M. Hopkins

Leeds Institute of Medical Research at St James's, University of Leeds, Leeds, UK and Malignant Hyperthermia Investigation Unit, Department of Anaesthesia, Leeds Teaching Hospitals NHS Trust, Leeds, UK

Rüffert et al. Br J Anaesth 136:653–661.doi:10.1016/j.bja.2025.11.006

BJA

British Journal of Anaesthesia, 136 (2): 653–661 (2026)

doi: 10.1016/j.bja.2025.11.006
Advance Access Publication Date: 1 January 2026
Special Article

QUALITY AND PATIENT SAFETY

European Malignant Hyperthermia Group 2025 guidelines for the investigation of malignant hyperthermia susceptibility

Henrik Rüffert[1,*], Robyn Gillies[2], Philip M. Hopkins[3], Klaus P. E. Glahn[4], Stephan Johannsen[5], Erik-Jan Kamsteeg[6], Anna Hellblom[7], Kathryn Stowell[8], Jonathan Bilmen[3], Martina Klincova[9], Thierry Girard[10] on behalf of the European Malignant Hyperthermia Group[†]

Universitätsspital Basel

Rüffert et al. Br J Anaesth 136:653–661.doi:10.1016/j.bja.2025.11.006

'Malignant hyperthermia (MH) is a potentially life-threatening clinical reaction originating from uncontrolled calcium release in skeletal muscle cells triggered by potent inhalational anaesthetic agents and/or suxamethonium (MH-trigger drugs). Clinical signs are characterised by a progressive hypermetabolic state but can also include muscle rigidity and/or rhabdomyolysis.'

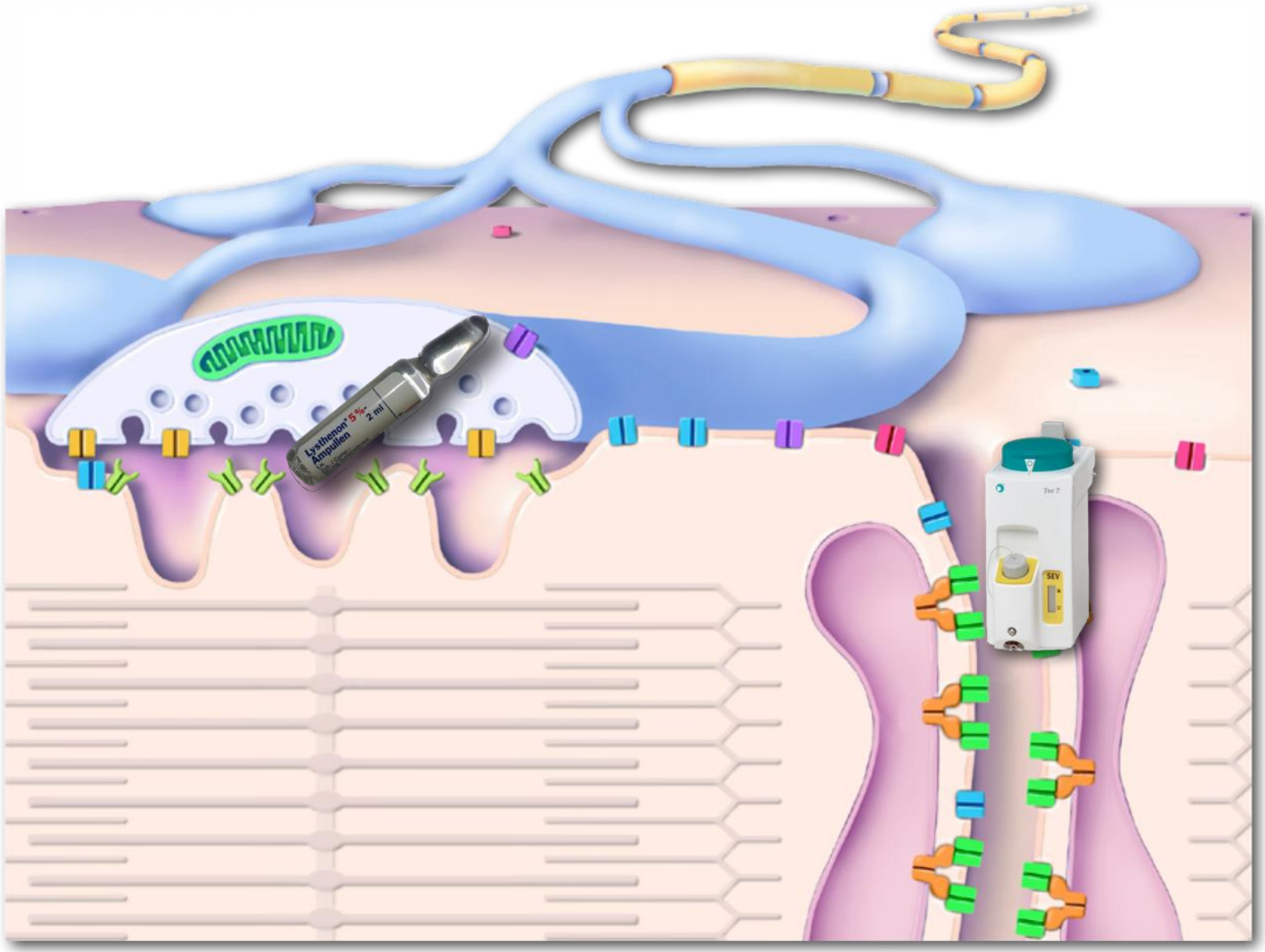
Triggersubstanzen



Succinylcholin



Alle halogenierten volatile Anästhetika



Proc. Natl . Acad. Sci . 1999:4759-4766

Universitätsspital Basel

Glahn et al. Br J Anaesth. 2025;134:221-223. PMID:39482150 doi:10.1016/j.bja.2024.09.022

Clinical signs

Early signs

Metabolic

- Inappropriately elevated CO_2 production (raised end-tidal CO_2 on capnography, tachypnoea if breathing spontaneously)
- Increased O_2 consumption
- Mixed metabolic and respiratory acidosis
- Profuse sweating and mottling of skin

Cardiovascular

- Inappropriate increase in heart rate
- Cardiac arrhythmias (especially ectopic ventricular beats and ventricular bigeminy)
- Unstable arterial pressure

Muscle

- Masseter spasm if succinylcholine used
- Generalised muscle rigidity

Later signs

- Hyperkalaemia
- Rapid increase in core body temperature
- Grossly elevated blood creatine kinase concentration
- Grossly elevated blood myoglobin concentration
- Dark-coloured urine caused by myoglobinuria
- Severe cardiac arrhythmias and cardiac arrest
- Disseminated intravascular coagulation

- Unerklärter Ansteige von CO_2
- Erhöhter O_2 Verbrauch
- Gemischte Azidose
- Unerklärte Tachykardie
- Arrhythmien
- Blutdruckabfall
- Muskelrigidität

Prävalenz und Inzidenz

Prävalenz

compound heterozygous

2002

Anesthesiology 2002; 97:1067–74
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Presence of Two Different Genetic Traits in Malignant Hyperthermia Families

Implication for Genetic Analysis, Diagnosis, and Incidence of Malignant Hyperthermia Susceptibility

Nicole Monnier, Ph.D., Renée Krivosic-Horber, M.D.,† Jean-François Payen, M.D., Ph.D.,‡ Geneviève Kozak-Ribbens, M.D., Ph.D.,§ Yves Nivoche, M.D.,‖ Pascal Adnet, M.D.,†# Hugo Reyford, M.D.,†** Joël Lunardi, Ph.D.††*

1 in 2000-3000

2006

Anesthesiology 2006; 104:1146–54
© 2006 American Society of Anesthesiologists, Inc. Lippincott Williams & Wilkins, Inc.

Malignant Hyperthermia in Japan

Mutation Screening of the Entire Ryanodine Receptor Type 1 Gene Coding Region by Direct Sequencing

Carlos A. Ibarra M., M.D., Ph.D., Shiwen Wu, M.D.,* Kumiko Murayama, B.S.,† Narihiro Minami, M.Sc.,‡ Yasuko Ichihara, M.D., Ph.D.,§ Hirosato Kikuchi, M.D., Ph.D.,‖ Satoru Noguchi, Ph.D.,# Yukiko K. Hayashi, M.D., Ph.D.,# Ryoichi Ochiai, M.D., Ph.D.,** Ichizo Nishino, M.D., Ph.D.,††*

1 in 2000

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Prävalenz

1 in 1556

122 von 190 312: 1 in 1556 (95% CI 1 in 1873 to 1 in 1303)

Br J Anaesth 2019;123(3):e461-e463.

Estimating prevalence of malignant hyperthermia susceptibility through population genomics data

Ognoon Mungunsukh, Patricia Deuster, Sheila Muldoon, Francis O'Connor and Nyamkhishig Sambuughin*

Bethesda, MD, USA

*Corresponding author. E-mail: nyamkhishig.sambuughin.ctr@usuhs.edu

Prävalenz

1 in 605

215 von 130 048: 1 in 605 (95% CI 1 in 700 to 1 in 530)

Am J Med Genet C Semin Med Genet. 2021;187:83-94.

Received: 8 December 2020 | Revised: 24 December 2020 | Accepted: 28 December 2020

DOI: 10.1002/ajmg.c.31887

RESEARCH ARTICLE

AMERICAN JOURNAL OF medical genetics PART C Seminars in Medical Genetics

WILEY

Leveraging population-based exome screening to impact clinical care: The evolution of variant assessment in the Geisinger MyCode research project

Melissa A Kelly | Joseph B Leader | Karen E Wain | Dale Bodian | Matthew T Oetjens | David H Ledbetter | Christa L Martin | Natasha T Strande

Muskelerkrankungen und MH

Check for updates

Received: 1 June 2022 | Accepted: 11 August 2022

DOI: 10.1111/ene.15526

european journal of neurology
the official journal of the european academy of neurology

CONSENSUS STATEMENT

European Neuromuscular Centre consensus statement on anaesthesia in patients with neuromuscular disorders

Luuk R. van den Bersselaar[1,2] | Luc Heytens[3] | Helga C. A. Silva[4] | Jens Reimann[5] | Giorgio Tasca[6] | Óscar Díaz-Cambronero[7] | Nicoline Løkken[8] | Anna Hellblom[9] | Philip M. Hopkins[10] | Henrik Rueffert[11] | Börge Bastian[11] | Juan Jesus Vilchez[12] | Robyn Gillies[13] | Stephan Johannsen[14] | Francis Veyckemans[15] | Tino Muenster[16] | Andrea Klein[17,18] | Ron Litman[19] | Heinz Jungbluth[20,21] | Sheila Riazi[22] | Nicol C. Voermans[2] | Marc M. J. Snoeck[1]

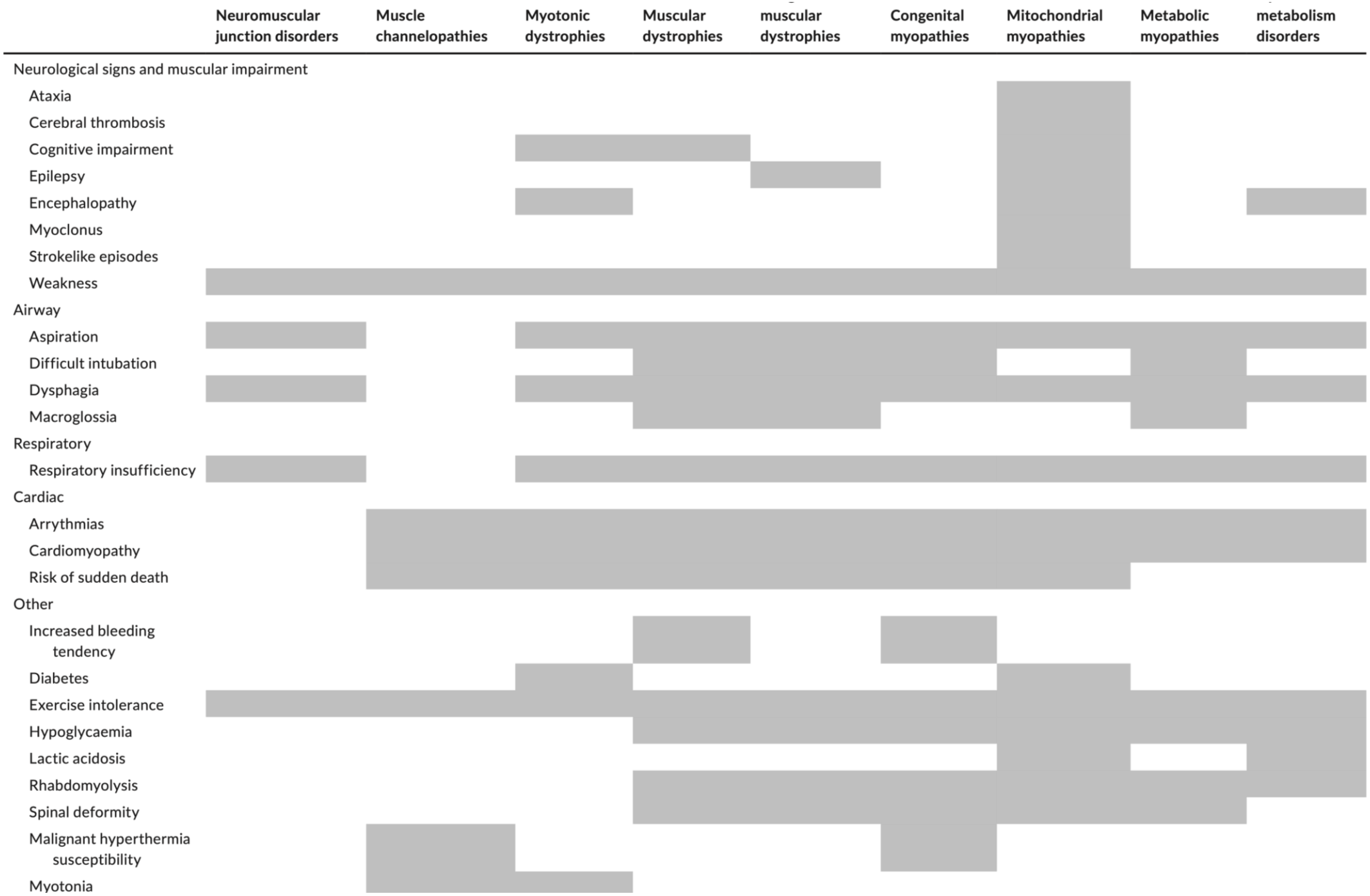
AIR: anaesthesia induced rhabdomyolysis

Beispiel Muskeldystrophie

Preoperative recommendations

- There is a need for a thorough preoperative evaluation: consideration of the exact molecular diagnosis, extent of muscle weakness, and specific assessment of cardiorespiratory involvement depending on the specific genetic background [13, 15–17, 82]. FSHD and OPMD are only exceptionally associated with cardiorespiratory involvement.
- Preoperative airway assessment in patients with DMD at an advanced disease stage (i.e., wheelchair-bound patients) requires special attention [21].
- In DMD patient, CNS involvement manifesting as cognitive deficits, speech problems, and psychiatric comorbidities such as anxiety and depression may complicate preoperative counselling [81].
- An intravenous hydrocortisone stress regimen should be considered in patients who are or were recently (<1 year) on a course of corticosteroids (prednisolone ≥5 mg/day for >1 month) [60].

- AIR seems to be a specific complication of general anaesthesia in dystrophinopathies, especially at paediatric age. AIR can cause life-threatening hyperkalaemia, and the risk of occurrence is possibly linked to the use of succinylcholine and/or volatile anaesthetics [33, 34]. This is an important consideration in the choice of anaesthetic drugs as part of a comprehensive risk–benefit comparison between alternative techniques for the individual patient.
- There is no association with MH [33].
- Impaired primary haemostasis and increased blood loss have been reported in DMD due to impaired vessel reactivity [83, 84].
- We have not found any reports of AIR associated with dystrophies other than DMD and BMD but cannot exclude the hypothetical risk of AIR on exposure to volatile anaesthetics, particularly in LGMDs where genetic variants affect proteins involved in sarcolemmal stability [33].


Neuromuscular junction disorders
Muscle channelopathies
Myotonic dystrophies
Muscular dystrophies
muscular dystrophies
Congenital myopathies
Mitochondrial myopathies
Metabolic myopathies
metabolism disorders
Neurological signs and muscular impairment
Ataxia
Cerebral thrombosis
Cognitive impairment
Epilepsy
Encephalopathy
Myoclonus
Strokelike episodes
Weakness
Airway
Aspiration
Difficult intubation
Dysphagia
Macroglossia
Respiratory
Respiratory insufficiency
Cardiac
Arrythmias
Cardiomyopathy
Risk of sudden death
Other
Increased bleeding tendency
Diabetes
Exercise intolerance
Hypoglycaemia
Lactic acidosis
Rhabdomyolysis
Spinal deformity
Malignant hyperthermia susceptibility
Myotonia

Snoeck et al. Br J Anaesth 137:721–731.doi:10.1016/j.bja.2026.06.011

BJA

British Journal of Anaesthesia, xxx (xxx): xxx (xxxx)

doi: 10.1016/j.bja.2026.06.011
Advance Access Publication Date: xxx
Special Article

SPECIAL ARTICLE

Consensus guideline from the European Malignant Hyperthermia Group on perioperative management of patients with an inherited primary disorder of skeletal muscle

Marc M. J. Snoeck[1,*], Robyn Gillies[2], Helga C. Almeida da Silva[3], Henrik Rüffert[4], Thierry Girard[5], Anna Hellblom[6], Philip M. Hopkins[7], Stephan Johannsen[8], Klaus P. E. Glahn[9] on behalf of the European Malignant Hyperthermia Group[#]

Universitätsspital Basel

Snoeck et al. Br J Anaesth 137:721–731.doi:10.1016/j.bja.2026.06.011

Aspekte

Maligne Hyperthermie vs. Perioperative Rhabdomyolyse

- Herzbeteiligung
- Lungenbeteiligung
- Empfindlichkeit auf Benzodiazepine
- Aktive Erwärmung
- Volatile Anästhetika vs. Propofol
- Upgregulation der Acetylcholine Rezeptoren
- Cholinesterasehemmer (Neostigmin)
- Objektives neuromuskuläres Monitoring

Maligne Hyperthermie

- Erhöhter Zellstoffwechsel
  - Rigidität
  - Masseterspasmus
  - Hohes CO2

- Behandlung
  - Trigger stoppen
  - Dantrolen

Rhabdomyolyse

- Muskelzerfall
  - Hyperkaliämie
  - Hohe T-Wellen
  - Bradykardie / Asystolie

  - Behandlung
    - CPR
    - Kalium senken

Inzidenz - Penetranz

ANESTHESIOLOGY

An Assessment of Penetrance and Clinical Expression of Malignant Hyperthermia in Individuals Carrying Diagnostic Ryanodine Receptor 1 Gene Mutations

Carlos A. Ibarra Moreno, M.D., Ph.D., Sally Hu, M.D., Natalia Kraeva, Ph.D., Frank Schuster, M.D., Stephan Johannsen, M.D., Henrik Rueffert, M.D., Werner Klingler, M.D., Ph.D., Luc Heytens, M.D., Ph.D., Sheila Riazi, M.Sc., M.D.

Anesthesiology 2019; XXX:00–00

ABSTRACT

Background: Malignant hyperthermia (MH) is a potentially lethal disorder triggered by certain anesthetics. Mutations in the ryanodine receptor 1 (*RYR1*) gene account for about half of MH cases. Discordance between the low incidence of MH and a high prevalence of mutations has been attributed to incomplete penetrance, which has not been quantified yet. The authors aimed to examine penetrance of MH-diagnostic *RYR1* mutations and the likelihood of mutation carriers to develop MH, and to identify factors affecting severity of MH clinical expression.

Methods: In this multicenter case–control study, data from 125 MH pedigrees between 1994 and 2017 were collected from four European registries and one Canadian registry. Probands (survivors of MH reaction) and their relatives with at least one exposure to anesthetic triggers, carrying one diagnostic *RYR1* mutation, were included. Penetrance (percentage of probands among all genotype-positive) and the probability of a mutation carrier to develop MH were obtained. MH onset time and Clinical Grading Scale score were used to assess MH reaction severity.

Results: The overall penetrance of nine *RYR1* diagnostic mutations was 40.6% (93 of 229), without statistical differences among mutations. Likelihood to develop MH on exposure to triggers was 0.25 among all *RYR1* mutation carriers, and 0.76 in probands (95% CI of the difference 0.41 to 0.59). Penetrance in males was significantly higher than in females (50% [62 of 124] *vs.* 29.7% [30 of 101]; $P = 0.002$). Males had increased odds of developing MH (odds ratio, 2.37; 95% CI, 1.36 to 4.12) despite similar levels of exposure to trigger anesthetics. Proband's median age was 12 yr (interquartile range 6 to 32.5).

Conclusions: Nine MH-diagnostic *RYR1* mutations have sex-dependent incomplete penetrance, whereas MH clinical expression is influenced by patient's age and the type of anesthetic. Our quantitative evaluation of MH penetrance reinforces the notion that a previous uneventful anesthetic does not preclude the possibility of developing MH.

(Anesthesiology 2019; XXX:00–00)

EDITOR'S PERSPECTIVE

What We Already Know about This Topic

- Malignant hyperthermia is a rare life-threatening disorder triggered in genetically predisposed individuals by exposure to certain anesthetics
- The ryanodine receptor 1 (*RYR1*) gene, which encodes the Ca2+ release channel of skeletal muscle sarcoplasmic reticulum, is the major malignant hyperthermia-associated locus
- Malignant hyperthermia diagnostic mutations are more prevalent than the reported incidence of clinical malignant hyperthermia episodes because many mutation carriers are never exposed to anesthetic triggers and some may have several uneventful anesthetics before developing malignant hyperthermia reaction

What This Article Tells Us That Is New

- In a multicenter case-control study of 229 genotype-positive subjects with previous recorded exposure to trigger anesthetics, there were 93 malignant hyperthermia cases, for an overall penetrance for the analyzed *RYR1* mutations of 40.6%
- The probability of developing malignant hyperthermia on exposure to triggers was 0.25 among all *RYR1* mutation carriers and 0.76 in survivors of malignant hyperthermia reactions (95% CI of the difference 0.41 to 0.59)
- Young age, male sex, and the use of succinylcholine were major nongenetic risk factors influencing expression of the *RYR1* mutations conferring malignant hyperthermia susceptibility

Malignant hyperthermia (MH) is a rare life-threatening disorder caused by dysregulation of intracellular calcium homeostasis in skeletal muscle and triggered by exposure to certain anesthetics in genetically predisposed individuals.[1] A progressively better understanding of the pathomechanism of MH, advances in anesthesia monitoring, and the introduction of dantrolene have been crucial in reducing MH mortality, which remains around 10%.[2]

Variants in ryanodine receptor 1 (*RYR1*),[3] calcium voltage-gated channel subunit alpha1 S (*CACNA1S*),[4–6] and in SH3 and cysteine rich domain 3 (*STAC3*) genes[7] are associated with MH. The *RYR1* gene—encoding the Ca^{2+} release channel of skeletal muscle sarcoplasmic reticulum (RyR1)—is the major MH-associated locus, involved in more than half of MH cases, whereas variants in *CACNA1S* and *STAC3* account for less than 1%. At present, 48 *RYR1* and 2 *CACNA1S* variants are

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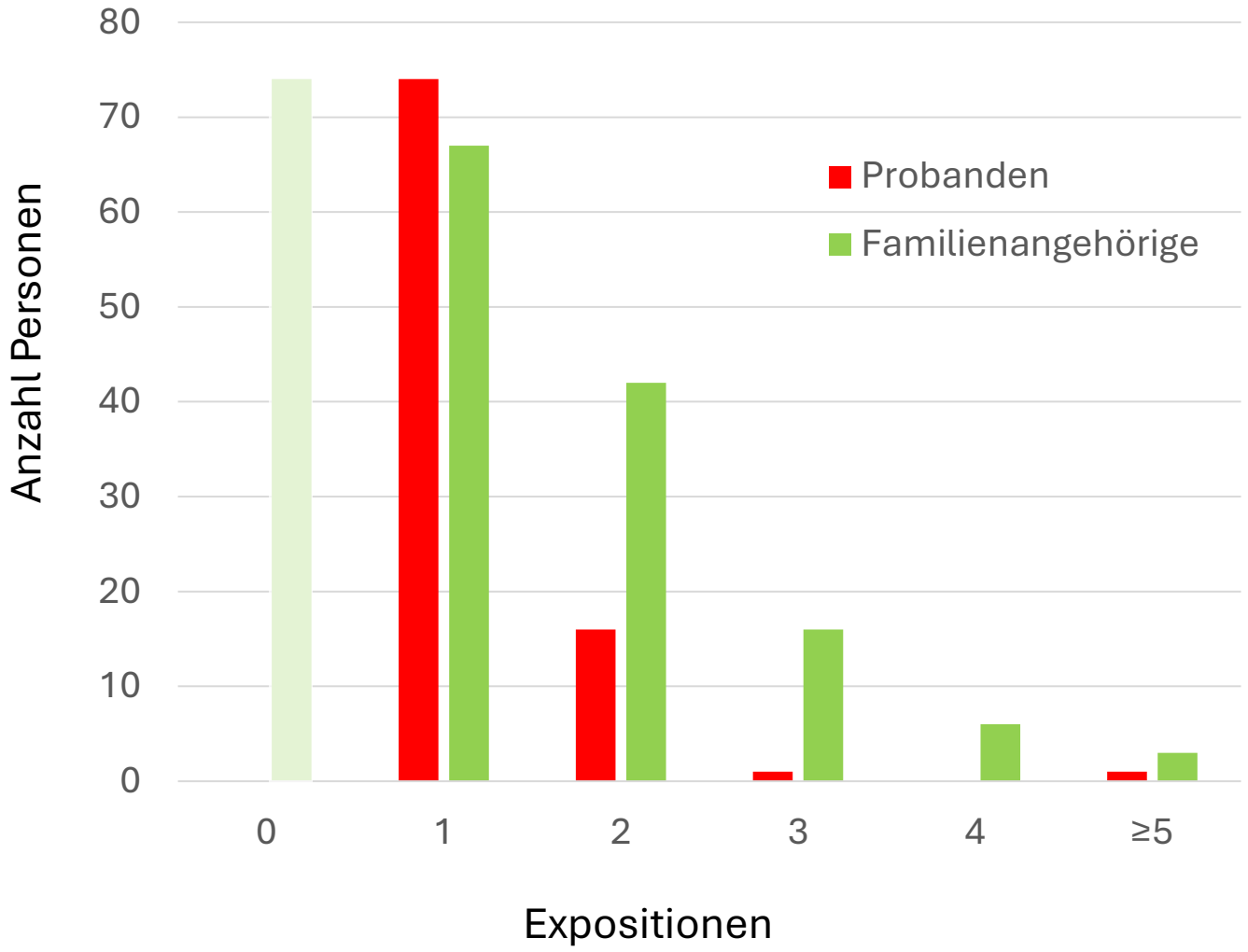
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<2doi,: DOI: 10.1097/ALN.0000000000002813>

Ibarra et al. Anesthesiology. 2019;131:983-991

Ibarra et al. Anesthesiology. 2019;131:983-991

Exposition mit Triggersubstanzen



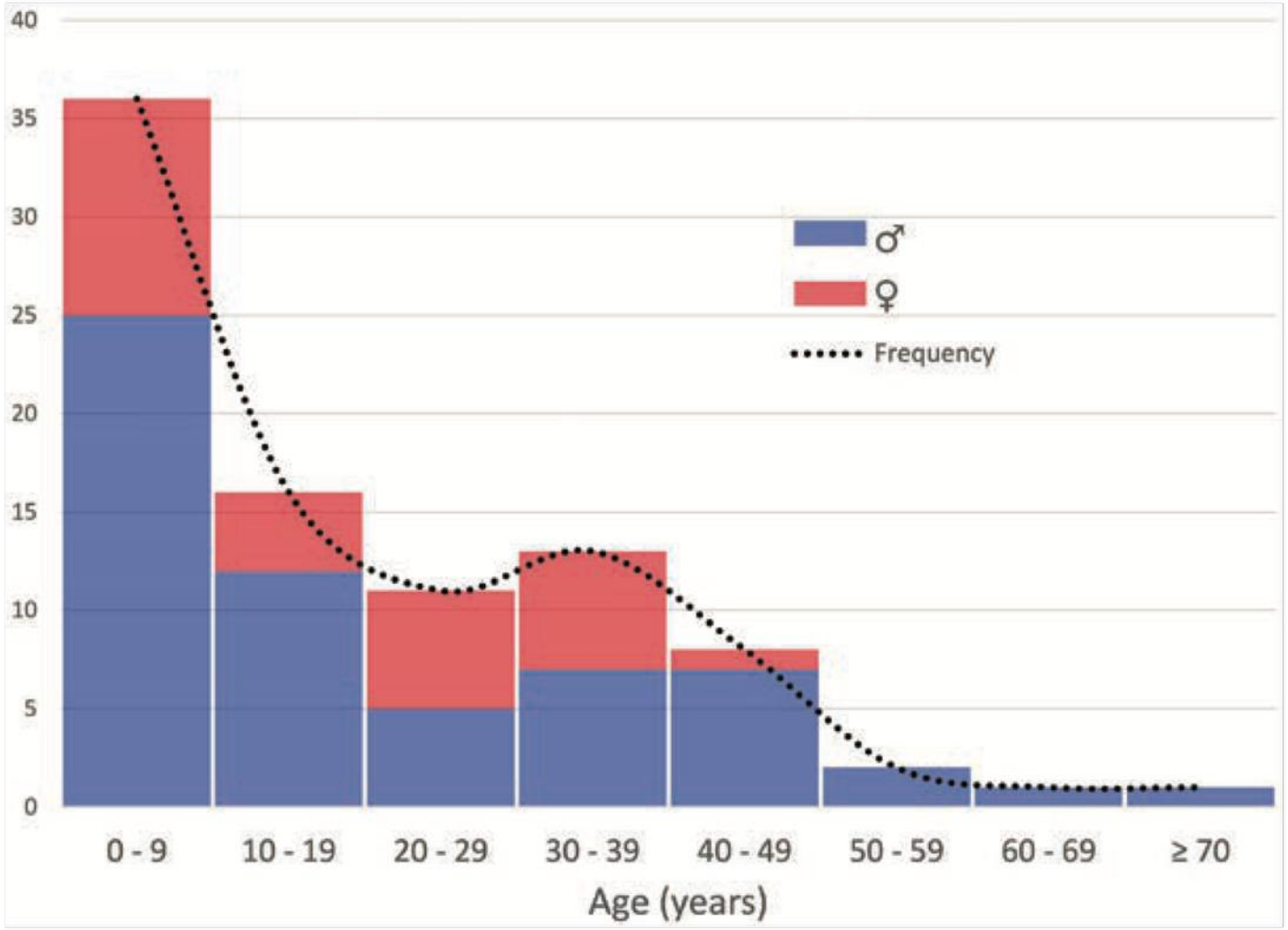
Penetranz allgemein: 40%

MH-Wahrscheinlichkeit Probanden: 0.76

MH-Wahrscheinlichkeit allgemein: 0.25

Ibarra et al. Anesthesiology. 2019;131:983-991

Alter & Geschlecht



Mehr Männer/Knaben

Jüngere Altersgruppen

ANESTHESIOLOGY

Evaluation of Malignant Hyperthermia Features in Patients with Pathogenic or Likely Pathogenic *RYR1* Variants Disclosed through a Population Genomic Screening Program

Kristen D. Yu, M.S., Megan N. Betts, M.S., Gretchen M. Urban, M.S., Marci L. B. Schwartz, Sc.M., Tanisha O. Robinson, M.D., Robert J. Moyer, M.D., Scott W. Taddonio, D.O., Anasuya Vasudevan, M.D., Alicia Johns, Ph.D., Amy C. Sturm, M.S., Melissa A. Kelly, M.S., Marc S. Williams, M.D., S. Mark Poler, M.D., Adam H. Buchanan, M.S., M.P.H.

ANESTHESIOLOGY 2024; 140:52–61

Keine MH Ereignisse

Total encounters with triggering agent	**126 /68**
Type of triggering agent given, n (%)	
Desflurane	23 (18.3%)
Desflurane/sevoflurane/succinylcholine	1 (0.8%)
Desflurane/succinylcholine	20 (15.9%)
Isoflurane	8 (6.3%)
Isoflurane/succinylcholine	4 (3.2%)
Sevoflurane	50 (39.7%)
Sevoflurane/desflurane	2 (1.6%)
Sevoflurane/desflurane/succinylcholine	2 (1.6%)
Sevoflurane/succinylcholine	13 (10.3%)
Succinylcholine	1 (0.8%)
Succinylcholine/desflurane	2 (1.6%)
Length of exposure, min (n = 115, missing = 11)	
Mean ± SD	131.0 ± 90.0
Median (25th, 75th percentiles)	101.0 (60.0, 178.0)
Minimum, maximum	25.0, 460.0
Dantrolene use (n = 126)	
n (%)	0 (0.0%)

Wichtigste Elemente der Therapie













BJA

British Journal of Anaesthesia, 134 (1): 221–223 (2025)

CORRESPONDENCE

Recognition and management of a malignant hyperthermia crisis: updated 2024 guideline from the European Malignant Hyperthermia Group

Klaus P. E. Glahn[1], Thierry Girard[2], Anna Hellblom[3], Philip M. Hopkins[4,*], Stephan Johannsen[5], Henrik Rüffert[6,7], Marc M. Snoeck[8], Albert Urwyler[2] on behalf of the European Malignant Hyperthermia Group[†]

[1]Danish Malignant Hyperthermia Centre, Department of Anaesthesia, Herlev University Hospital, Copenhagen, Denmark, [2]Department of Anaesthesiology, University Hospital Basel and University of Basel, Basel, Switzerland, [3]Department of Anaesthesia, University Hospital, Lund, Sweden, [4]Malignant Hyperthermia Unit, St James's University Hospital, Leeds, UK, [5]Department of Anaesthesia and Critical Care, University of Wuerzburg, Wuerzburg, Germany, [6]Helios Klinik Schkeuditz, Klinik für Anästhesie, Intensivmedizin, Schmerztherapie, Leipzig-Schkeuditz, Germany, [7]MH Center University Hospital Leipzig, Department of Anaesthesiology and Intensive Care Medicine, Leipzig, Germany and [8]Department of Anaesthesiology, Canisius-Wilhelmina Ziekenhuis, Nijmegen, The Netherlands

*Corresponding author. E-mail: p.m.hopkins@leeds.ac.uk
[†]The Collaborators are listed in Appendix.

Keywords: activated charcoal filters; dantrolene; guidelines; hyperkalaemia; inhalation anaesthetics; malignant hyperthermia; rhabdomyolysis; succinylcholine

Verdacht auf Maligne Hyperthermie

MH-Notfallnummer: 061 265 44 00

www.malignehyperthermie.ch
MHApp: http://appstore.com/mhapp

Sofortmassnahmen
- Trigger stop
- Verdampfer entfernen
- Atemminutenvolumen mind. verdoppeln
- FiO2 1.0 bei hohem Frischgasfluss
- Aktivkohlefilter* in- und expiratorisch
- Opioide, Benzod, Propofol
- Dantrolen vorbereiten !
- Labor abnehmen (s.unten)

*Aktivkohlefilter falls vorhanden
Der Respirator muss nicht gewechselt werden ! (Zeitverlust)

Sekundärmassnahmen
- Aktive Kühlung bis <38.5° (Oberflächenkühlung mit Eiswasser: Magen, Blase, Rektum, offenes Abdomen)
- Monitoring erweitern (Arterie, DK, ZVK)
- Diurese forcieren (Volumen!)

Hypermetabolismus ?
(erhöhte CO_2 Produktion)

Ja

Dantrolen 2-2.5 mg/kg KG intravenös als Bolus

- NaBic bei Azidose (evtl. blind 1-2 mval/kg)
- Antiarrhythmika (Amiodaron, Betablocker)
- Hyperkaliämie behandeln
- Abbruch OP erwägen

Häufig sind wiederholte Boli von 2-2.5 mg/kg zu applizieren.
Manchmal ist eine Totaldosis über 10 mg/kg (bis zu 30 mg/kg) notwendig.

Postoperativ
- Überwachung auf Intensivstation
- Dantrolen bei Hypermetabolismus erneut mit 2-2.5mg/kg
- Kontakt zum MH-Zentrum für Diagnostik (061 265 77 77)

Laboranalysen
- arterielle oder venöse Blutgasanalyse (mit Laktat)
- Elektrolyte
- Kreatinkinase (CK)
- Transaminasen
- Myoglobin

Im Urin:
- Myoglobin

Abnahmezeitpunkt:
- Bei Ereignis
- Nach 30 min, 4h, 12h, 24h

Agilus 120mg/Flasche

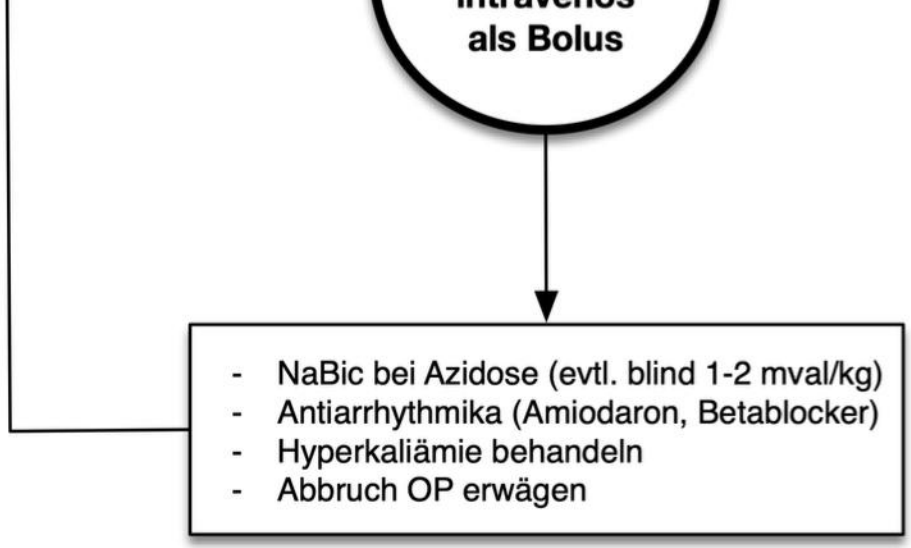
- Eine Flasche mit 120mg wird mit 20ml aqua ad inject. aufgelöst = 22.6ml
  WICHTIG: **KEIN** NaCl, sondern aqua ad inject.
- Bei 70 kg entsprechen 2.5 mg/kg = 175 mg, = 1.45 Flaschen (bei 5.3mg/ml = 33ml)

Dantrolen 20mg/Flasche

- Eine Flasche mit 20mg wird mit 60ml aqua ad inject. aufgelöst
  WICHTIG: **KEIN** NaCl, sondern aqua ad inject.
- 2.5 mg/kg entspricht bei 20mg/60ml 7.5 ml/kg KG
- Bei 70 kg entsprechen 2.5 mg/kg 175 mg, das sind 9 Flaschen (525ml)
- Eine Flasche Dantrolen enthält 3 g Mannitol, sowie NaBic, pH 9.0

Prof. Thierry Girard, MH-Zentrum Schweiz, Universitätsspital Basel, März 2025

https://www.malignehyperthermie.ch



- Elektrolyte
- Kreatinkinase (CK)
- Transaminasen
- Myoglobin

Im Urin:
- Myoglobin

Abnahmezeitpunkt:
- Bei Ereignis
- Nach 30 min, 4h, 12h, 24h

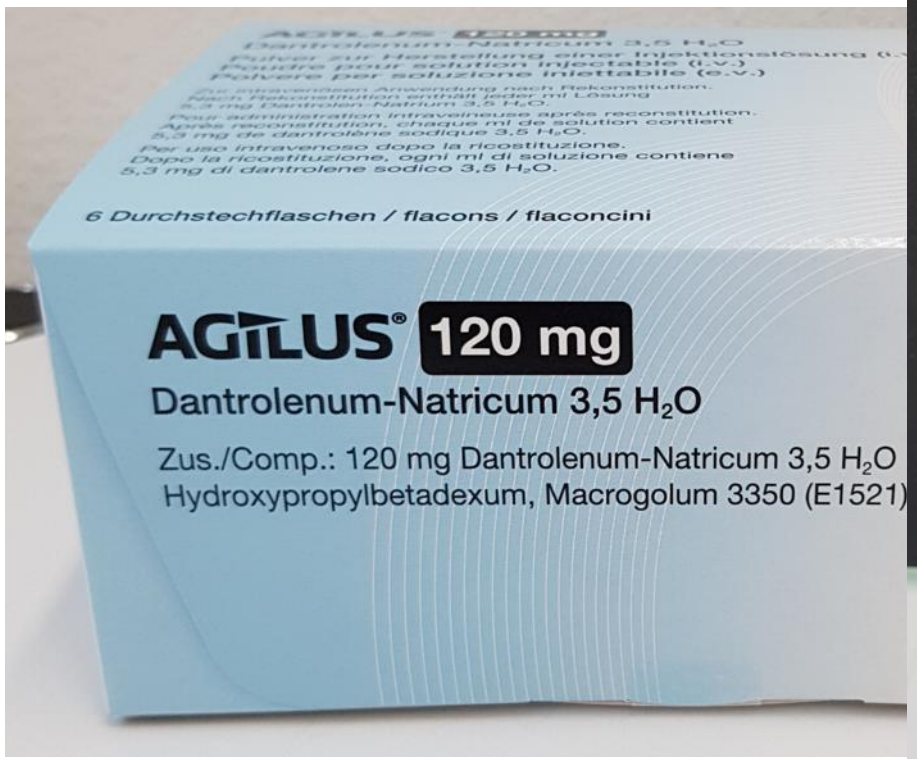
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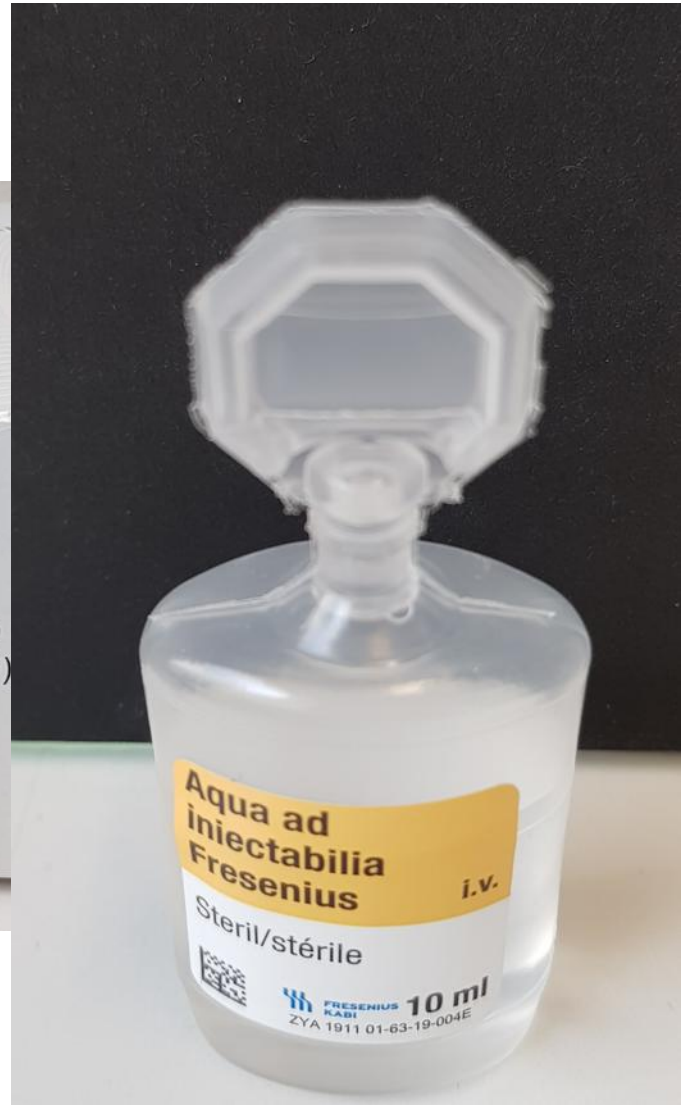
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Dantrolen 20mg/Flasche

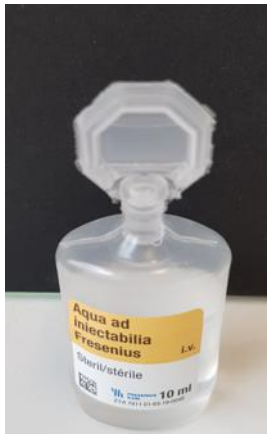
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AGILUS® 120 mg
Dantrolenum-Natricum 3,5 H_2O
Zus./Comp.: 120 mg Dantrolenum-Natricum 3,5 H_2O
Hydroxypropylbetadexum, Macrogolum 3350 (E1521)
6 Durchstechflaschen / flacons / flaconcini


Aqua ad iniectabilia
Fresenius
i.v.
Steril/stérile
10 ml
ZYA 1911 01-63-19-004E


AGILUS® 120 mg
Dantrolenum-Natricum

Dantrolen Agilus





- 120mg mit 20ml Aqua
- 22.6ml = 5.3 mg/ml
- 2-2.5mg / kg Körpergewicht

Diagnostik

Hopkins et al. Br J Anaesth. 2015;115:531-539.

Europäische MH Gruppe (EMHG)

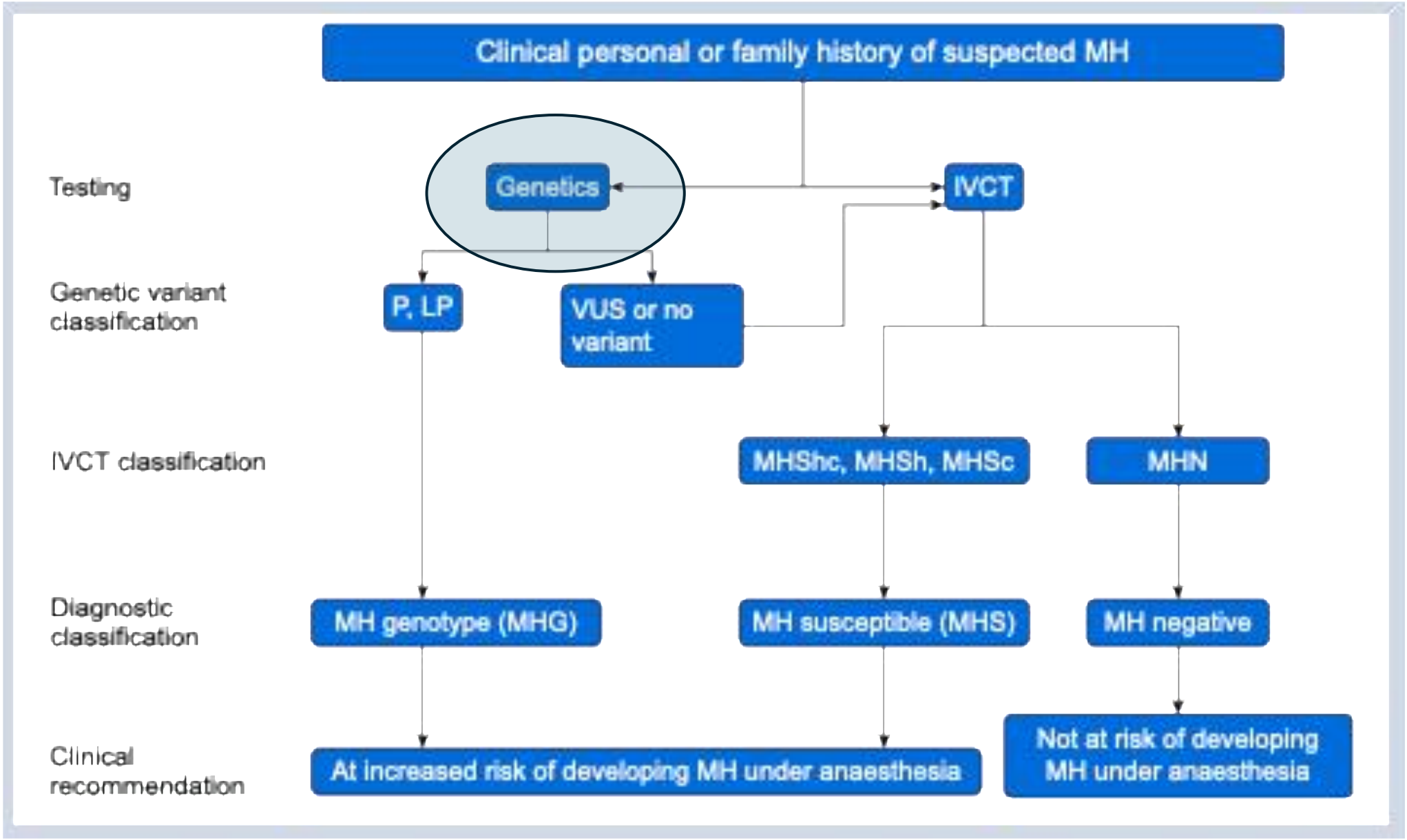
European Malignant Hyperthermia Group guidelines for investigation of malignant hyperthermia susceptibility

P. M. Hopkins[1,*], H. Rüffert[2,3], M. M. Snoeck[4], T. Girard[5], K. P. E. Glahn[6], F. R. Ellis[1], C. R. Müller[7] and A. Urwyler[5] on behalf of the European Malignant Hyperthermia Group[†]

[1]Malignant Hyperthermia Unit, Leeds Institute of Biomedical and Clinical Sciences, St James's University Hospital, Leeds, UK, [2]Department of Anaesthesiology and Intensive Care Medicine, University Hospital Leipzig, Leipzig, Germany, [3]Klinik für Anästhesie, Intensivmedizin, Schmerztherapie, Helios Klinik Schkeuditz, Schkeuditz, Germany, [4]Department of Anaesthesiology, Canisius-Wilhelmina Ziekenhuis, Nijmegen, The Netherlands, [5]Department of Anaesthesia and Research, University of Basel, Basel, Switzerland, [6]Danish Malignant Hyperthermia Centre, Department of Anaesthesia, University Hospital Herlev, Copenhagen, Denmark, and [7]Department of Human Genetics, University of Würzburg, Würzburg, Germany

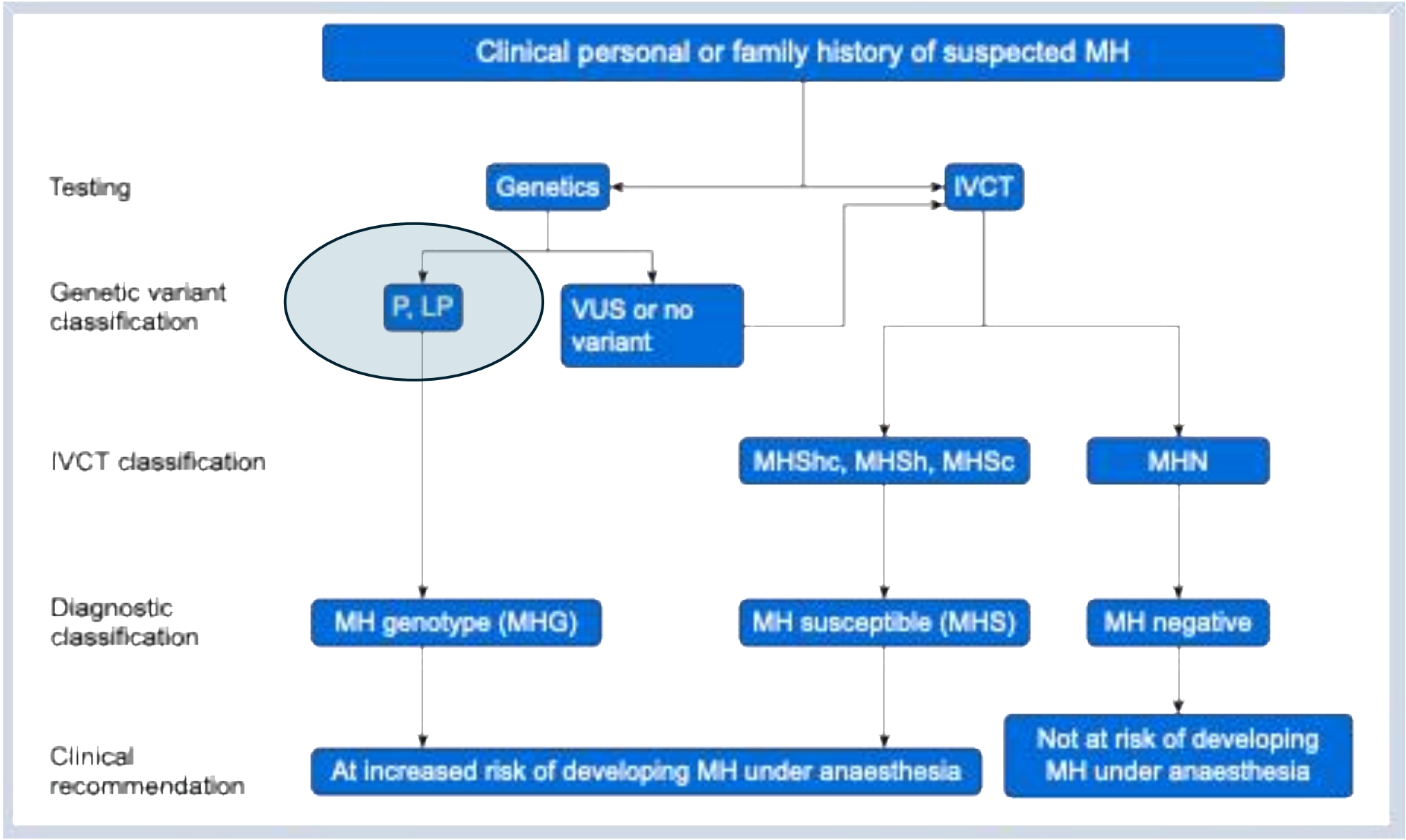
*Corresponding author. E-mail: p.m.hopkins@leeds.ac.uk

Rüffert et al. Br J Anaesth 136:653–661.doi:10.1016/j.bja.2025.11.006



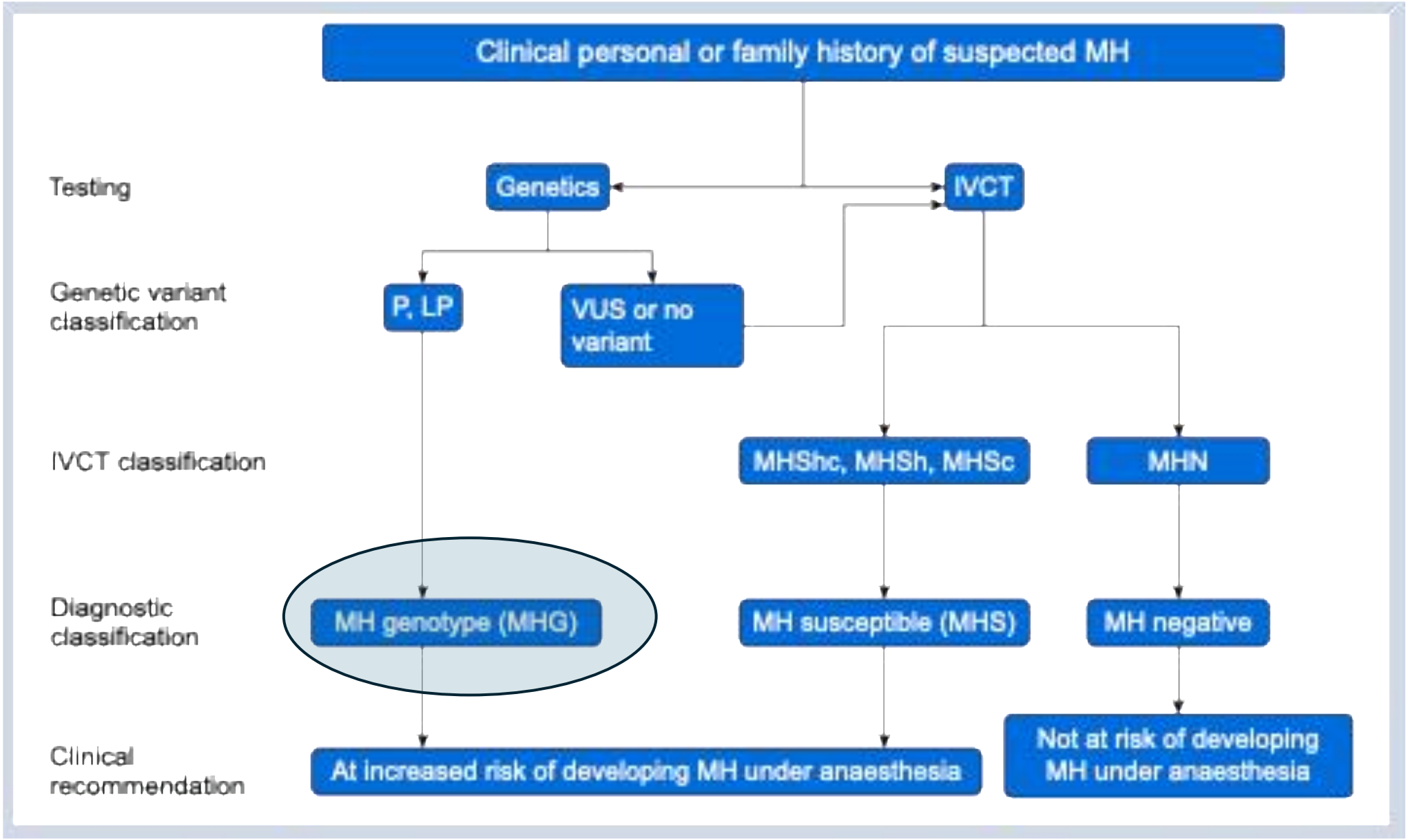
Universitätsspital Basel

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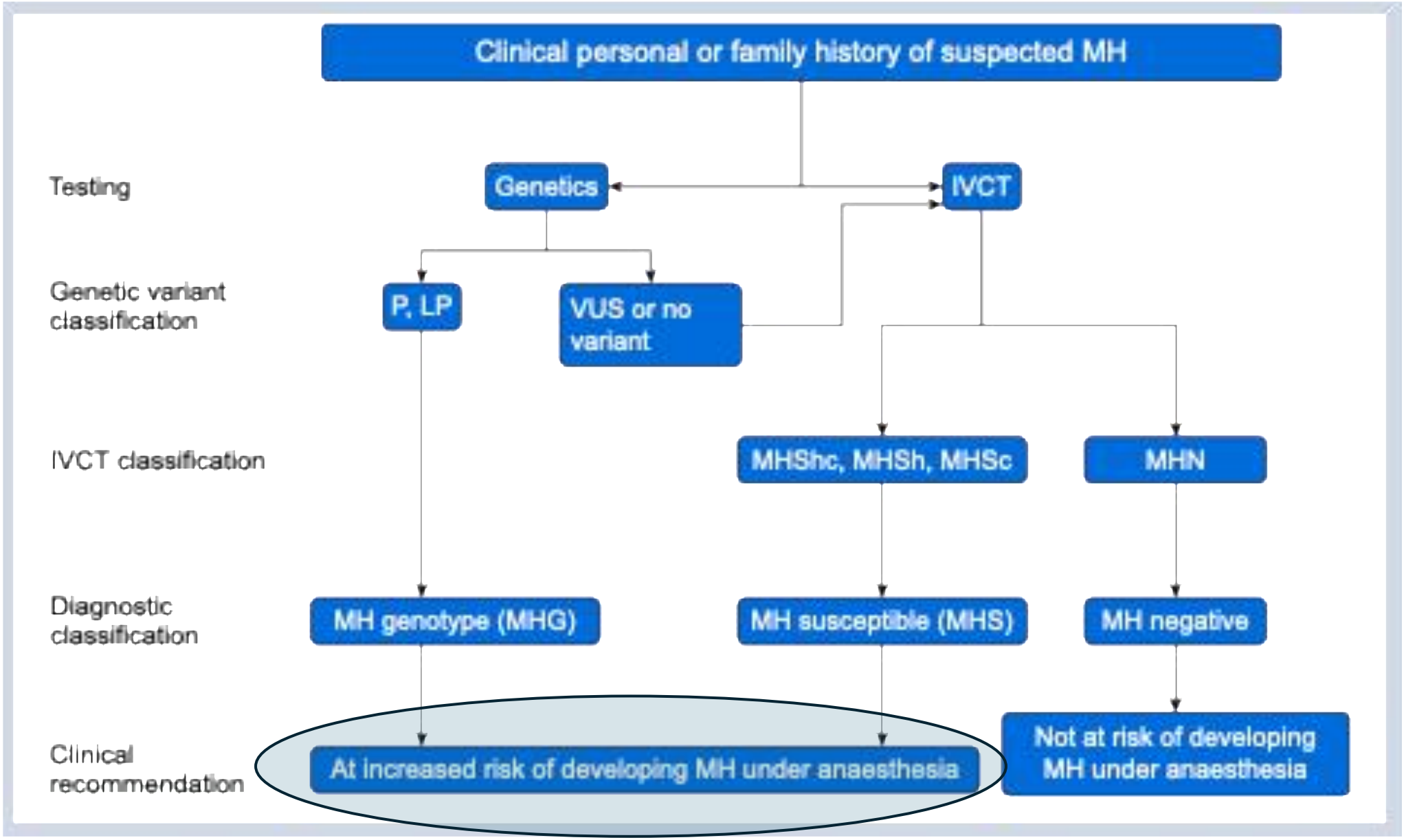
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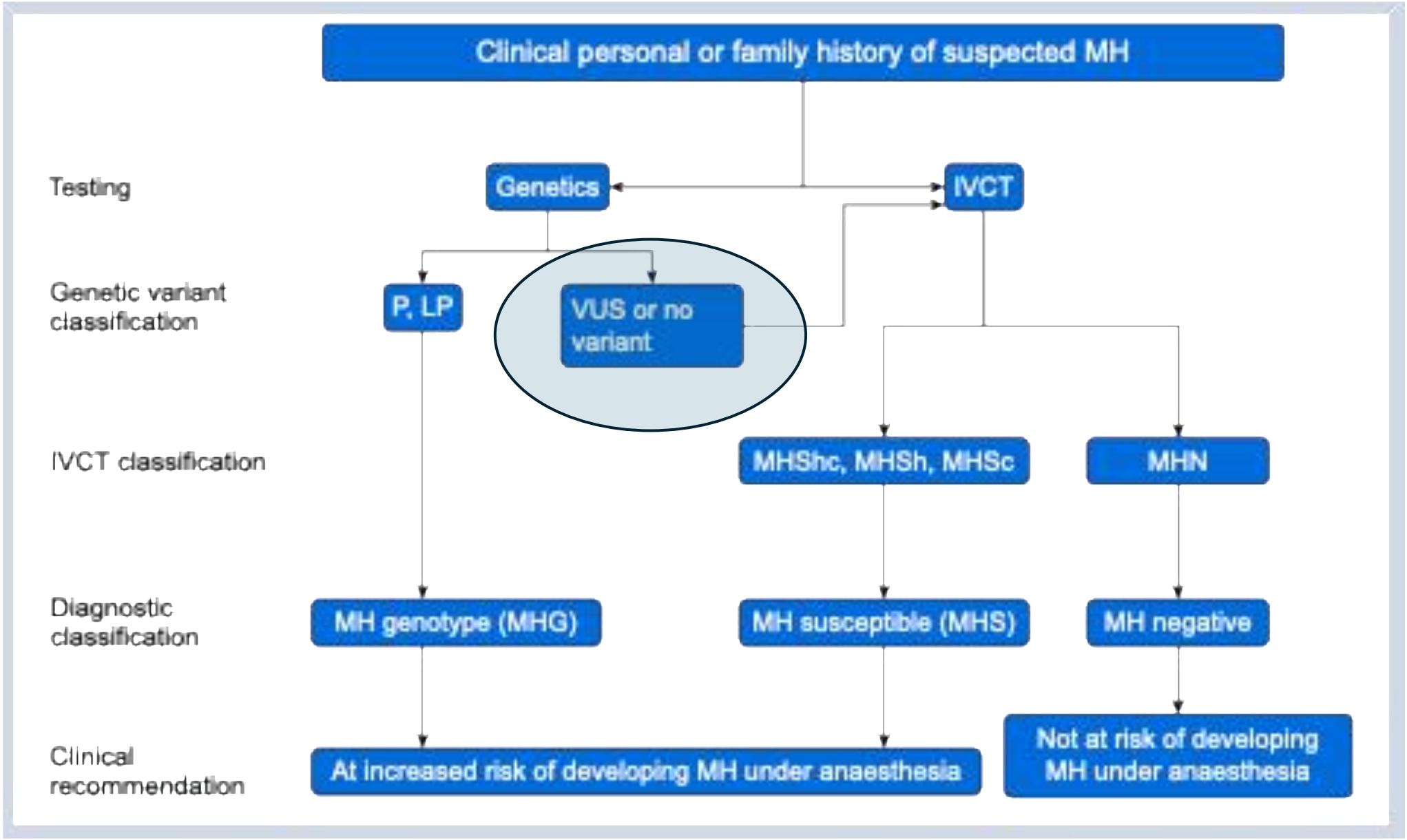
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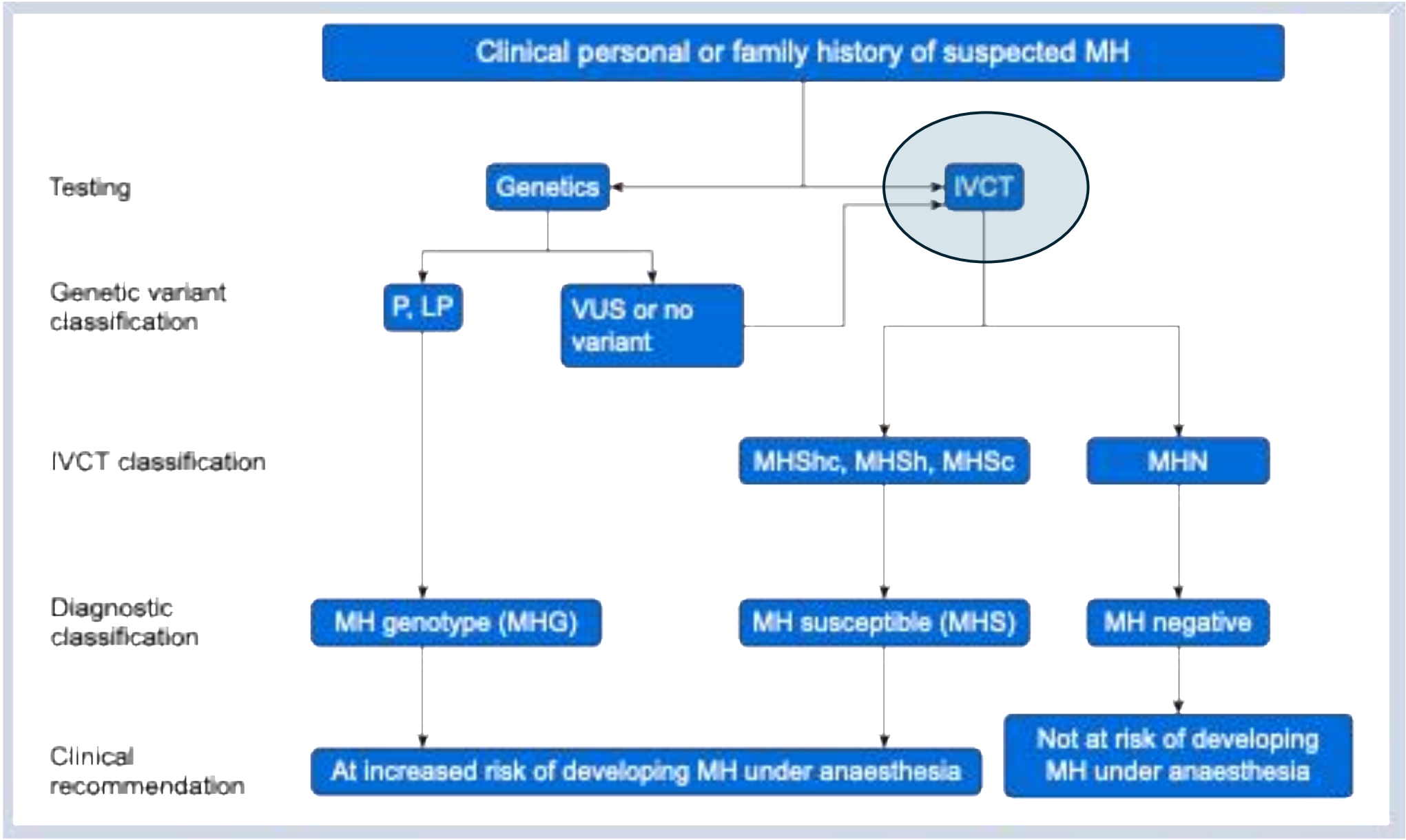
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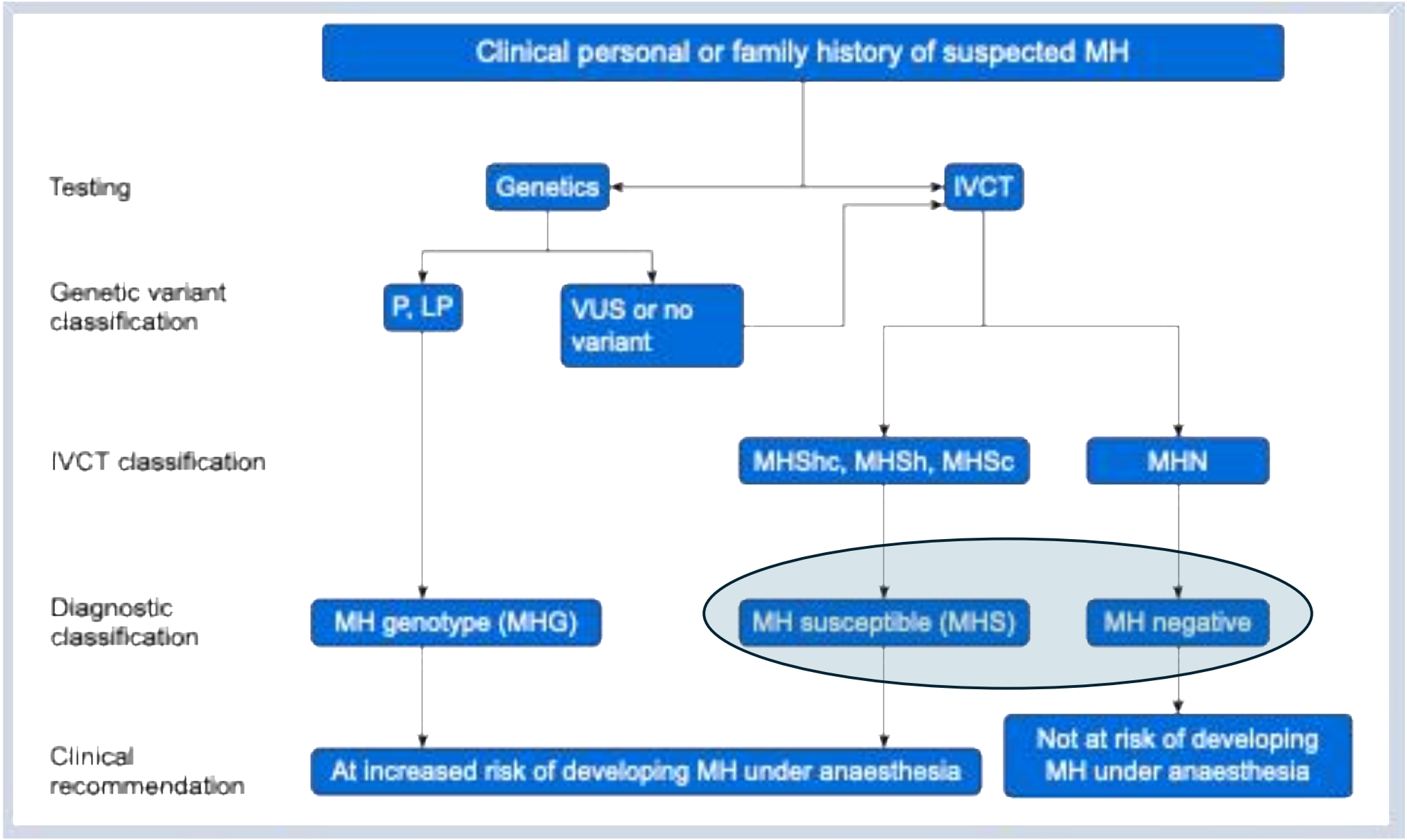
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Universitätsspital Basel

1. Détection de variant·s ponctuel·s (SNV) pathogène·s ou probablement pathogène·s:

Gène	RefSeq	Coordonnées (v. GRCh37; hg19)	Nucléotide	Acide aminé	Type	Zygosité	Classe
RYR1	MANE_Select-NM_000540.3	chr19:38'943'464	**c.1250T>C**	**p.Leu417Pro**	Faux sens	Hétérozygote	**Pathogène**
RYR1	MANE_Select-NM_000540.3	chr19:38'957'030_38'957'052	**c.3170_3178+14del**	**p.?**	Perte du site d'épissage	Hétérozygote	**Pathogène**

Statut de porteur des parents

Mère: ID 37653

Gène	RefSeq	Coordonnées (v. GRCh37; hg19)	Nucléotide	Acide aminé	Statut
RYR1	MANE_Select-NM_000540.3	chr19:38'943'464	c.1250T>C	p.Leu417Pro	Ne porte pas le variant
RYR1	MANE_Select-NM_000540.3	**chr19:38'957'030_38'957'052**	**c.3170_3178+14del**	**p.?**	**Porte le variant en hétérozygotie**

Père: ID 37652

Gène	RefSeq	Coordonnées (v. GRCh37; hg19)	Nucléotide	Acide aminé	Statut
RYR1	MANE_Select-NM_000540.3	**chr19:38'943'464**	**c.1250T>C**	**p.Leu417Pro**	**Porte le variant en hétérozygotie**
RYR1	MANE_Select-NM_000540.3	chr19:38'957'030_38'957'052	c.3170_3178+14del	p.?	Ne porte pas le variant

Gene

- RYR1 (Ryanodinrezeptor Typ 1)
- CACNA1S (Dihydropyridinrezeptor, Alpha-1 Untereinheit)
- STAC3

Freitag Abend – letzter Patient des Programms ist MH positiv: Was ist korrekt?

- Halogenierte volatile Anästhetika vermeiden
- Lachgas vermeiden
- Neostigmin vermeiden
- Respirator mit 10 l/min für 10 Minuten spülen
- Prämedikation mit oralem Dantrolen 2h präoperativ
- Operation absagen

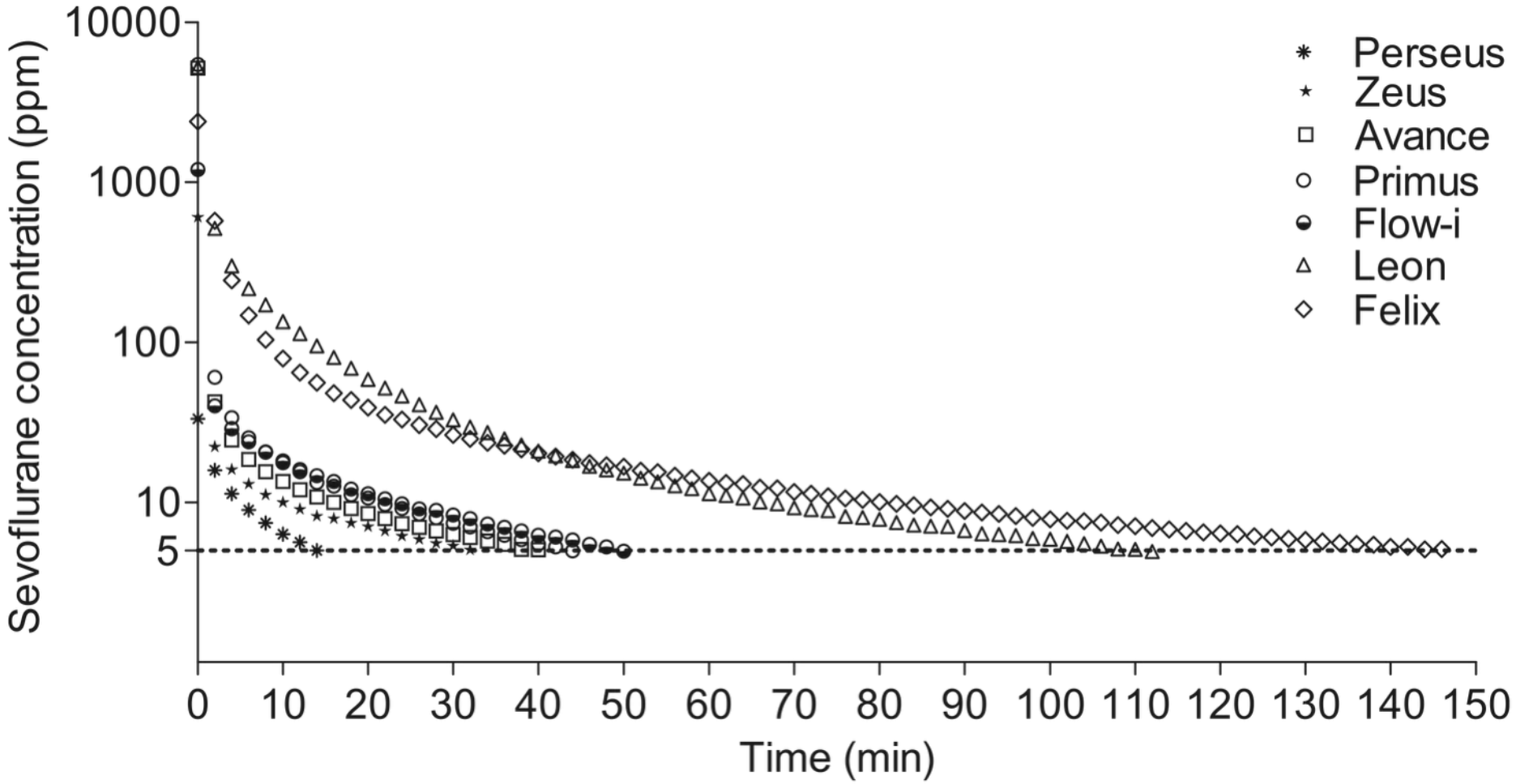
Anesth Analg. 2014;119(1):67–75.

The Sevoflurane Washout Profile of Seven Recent Anesthesia Workstations for Malignant Hyperthermia-Susceptible Adults and Infants: A Bench Test Study

Nicolas Cottron, MD, Claire Larcher, MD, Agnès Sommet, MD, PhD, Rose Fesseau, MD, Xavier Alacoque, MD, Vincent Minville, MD, PhD, Olivier Fourcade, MD, PhD, and Delphine Kern, MD, PhD

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- https://www.malignehyperthermie.ch
- https://www.emhg.org
- https://omim.org
- https://www.unispital-basel.ch/anaesthesiologie/maligne-hyperthermie

thierry.girard@usb.ch