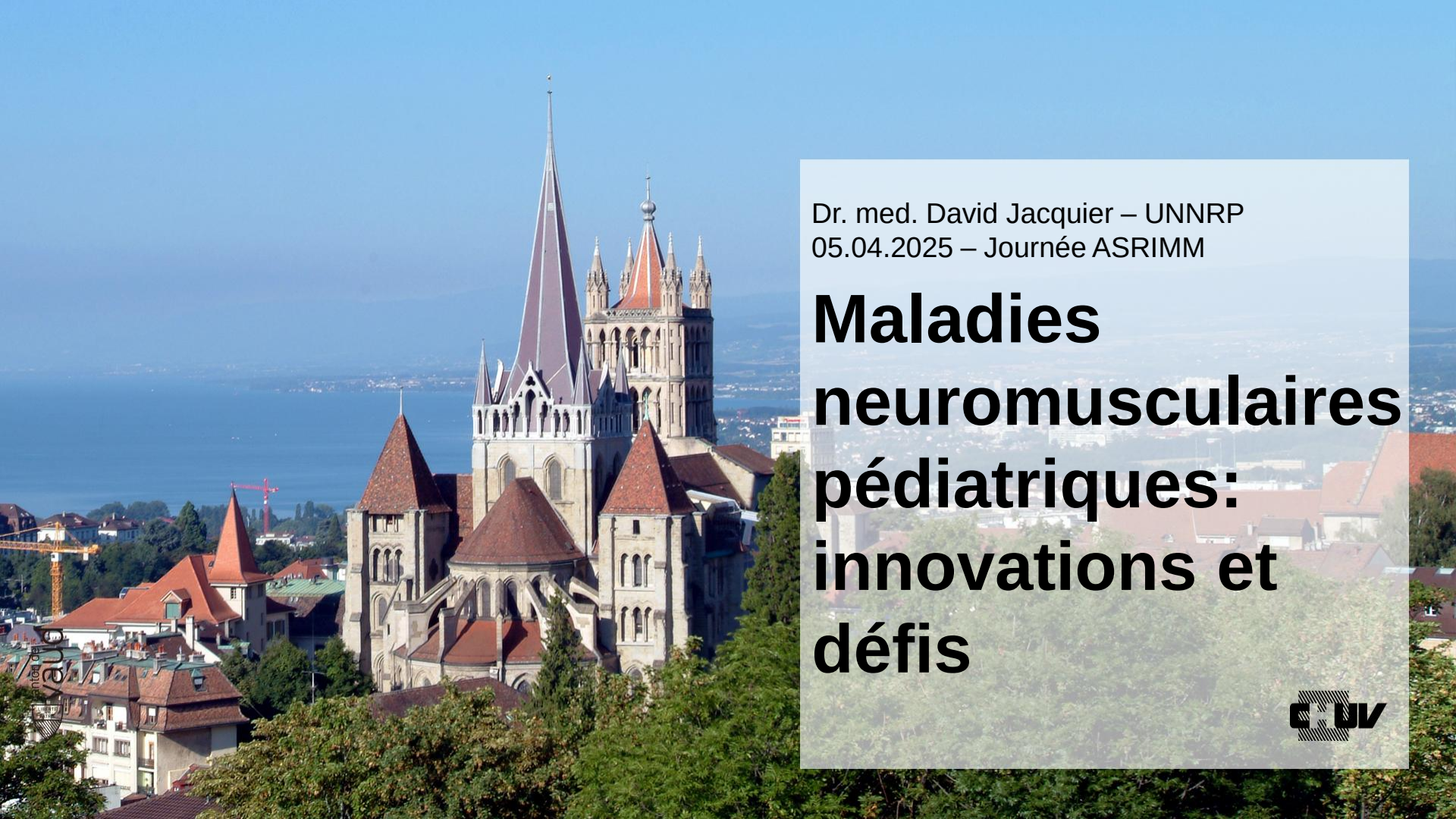


Dr. med. David Jacquier – UNNRP
05.04.2025 – Journée ASRIMM

Maladies neuromusculaires pédiatriques: innovations et défis

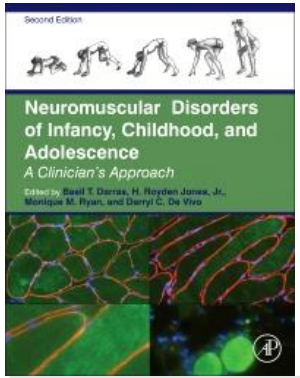
Déclaration

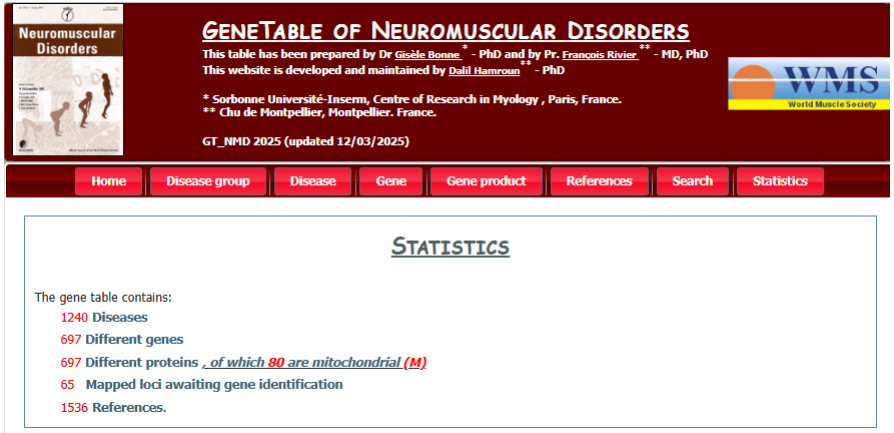
J’ai reçu via le CHUV des émoluments pour des activités de conseil scientifique pour Biogen, AveXis/Novartis Gene Therapies, Roche, Pfizer.

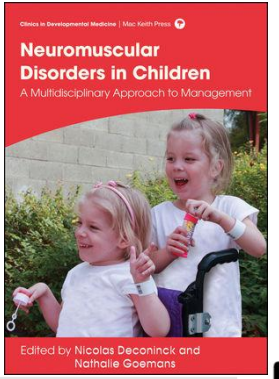
J’ai reçu un fonds de recherche de la part de Biogen, AveXis/Novartis Gene Therapies et Roche.

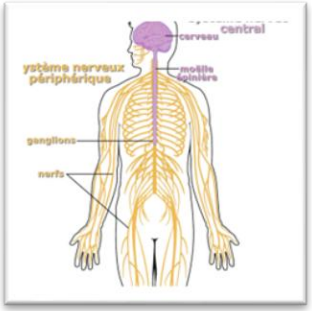
Maladies neuromusculaires

- Ensemble de maladies touchant la fonction motrice, du cerveau au muscle
- Grande majorité d'origine génétique
- Spectre très varié
- Maladies rares ou rarissimes

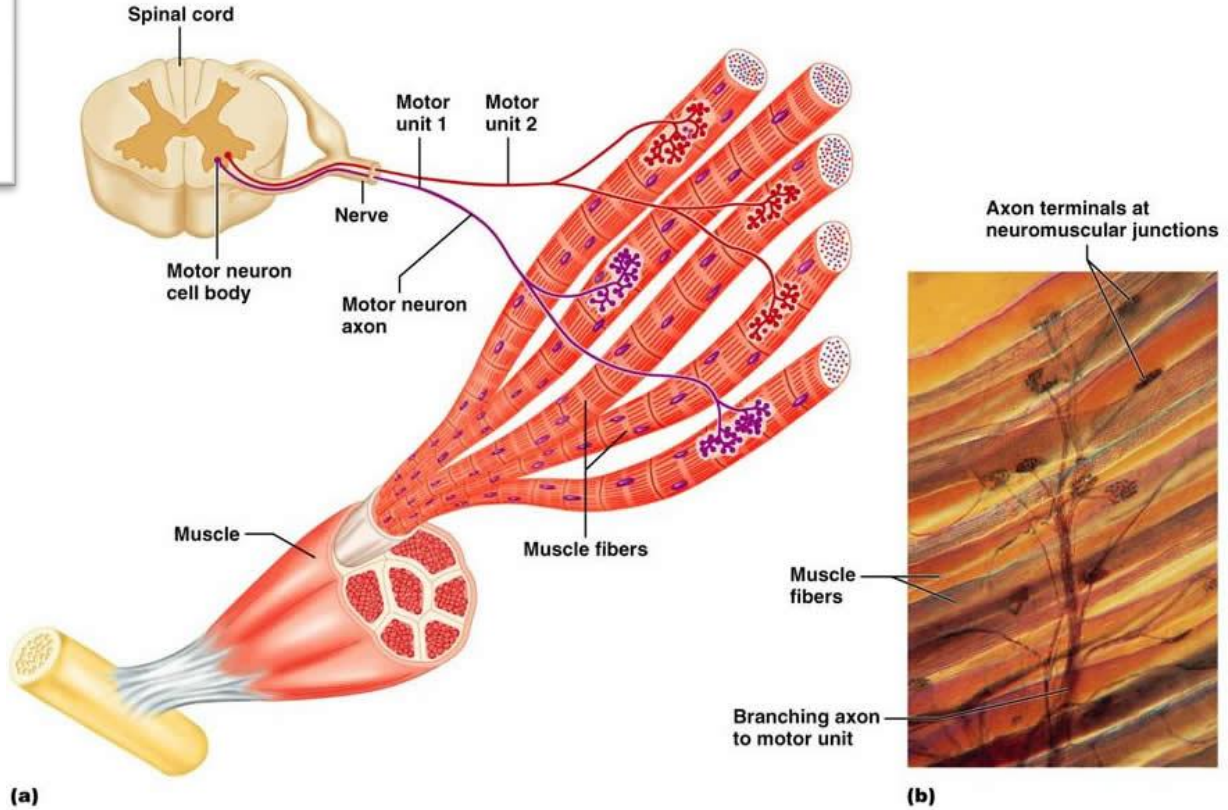






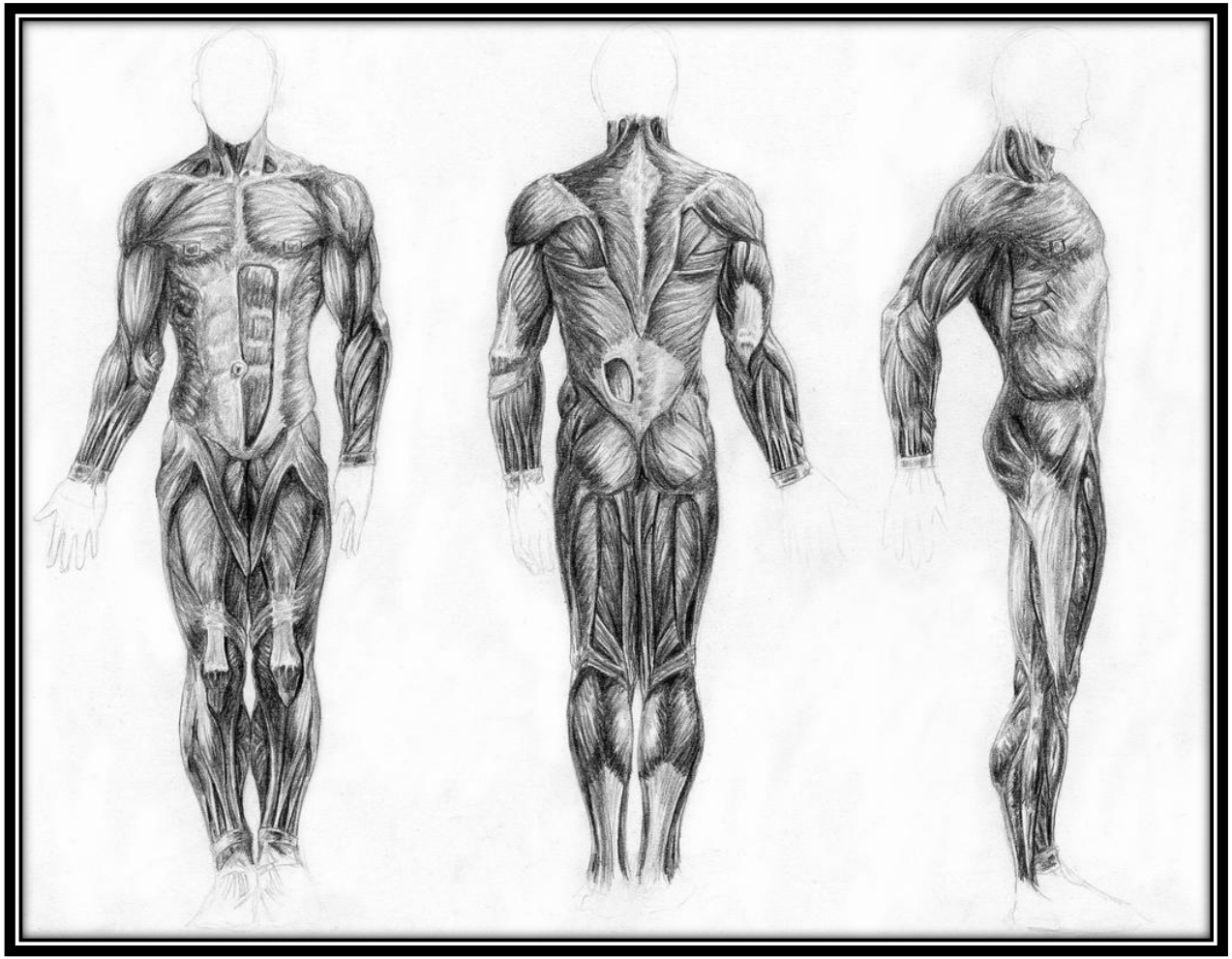


Classification des MNM



https://blogs.ncl.ac.uk/katarzynapirog/skeletal-muscle-structure-and-function/

640 muscles



muscles_of_the_body_by_arvalis.jpg (1024×791) (wixmp.com)

MNM = maladies multisystémiques

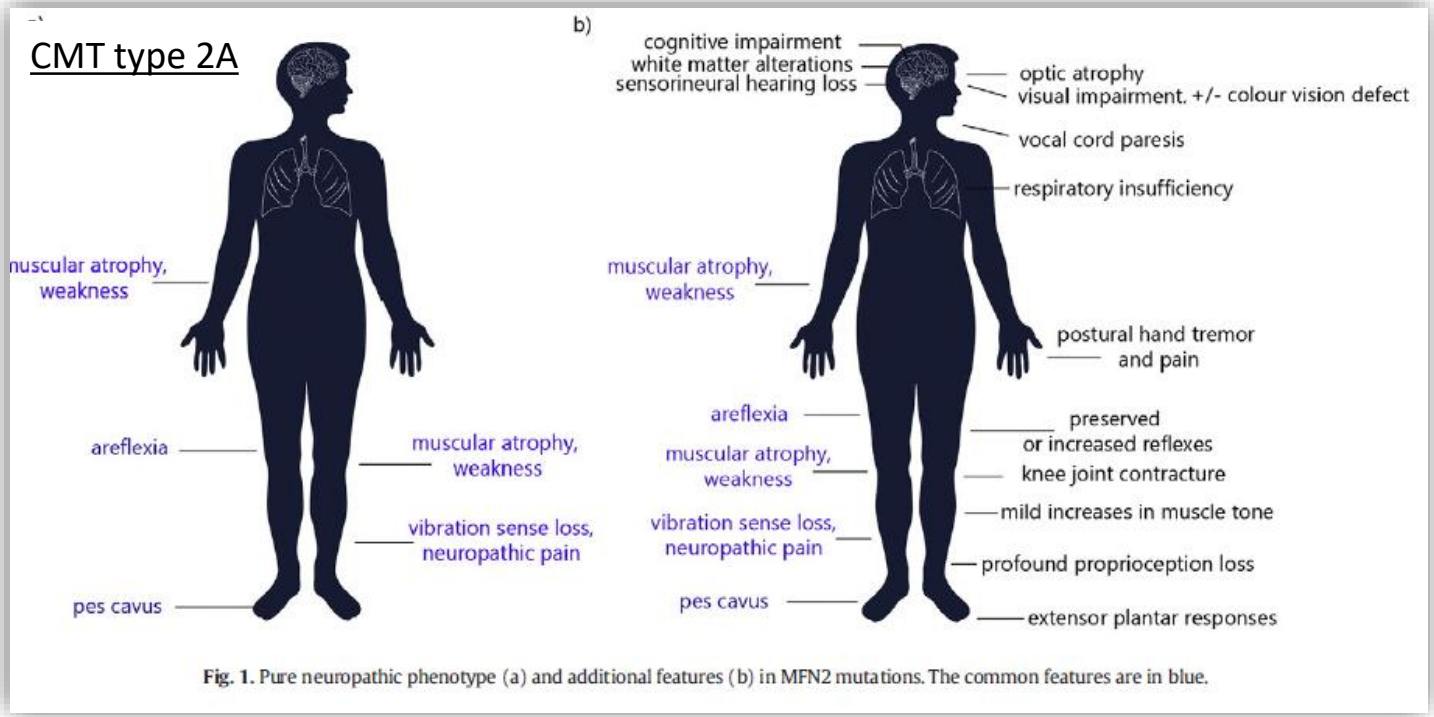
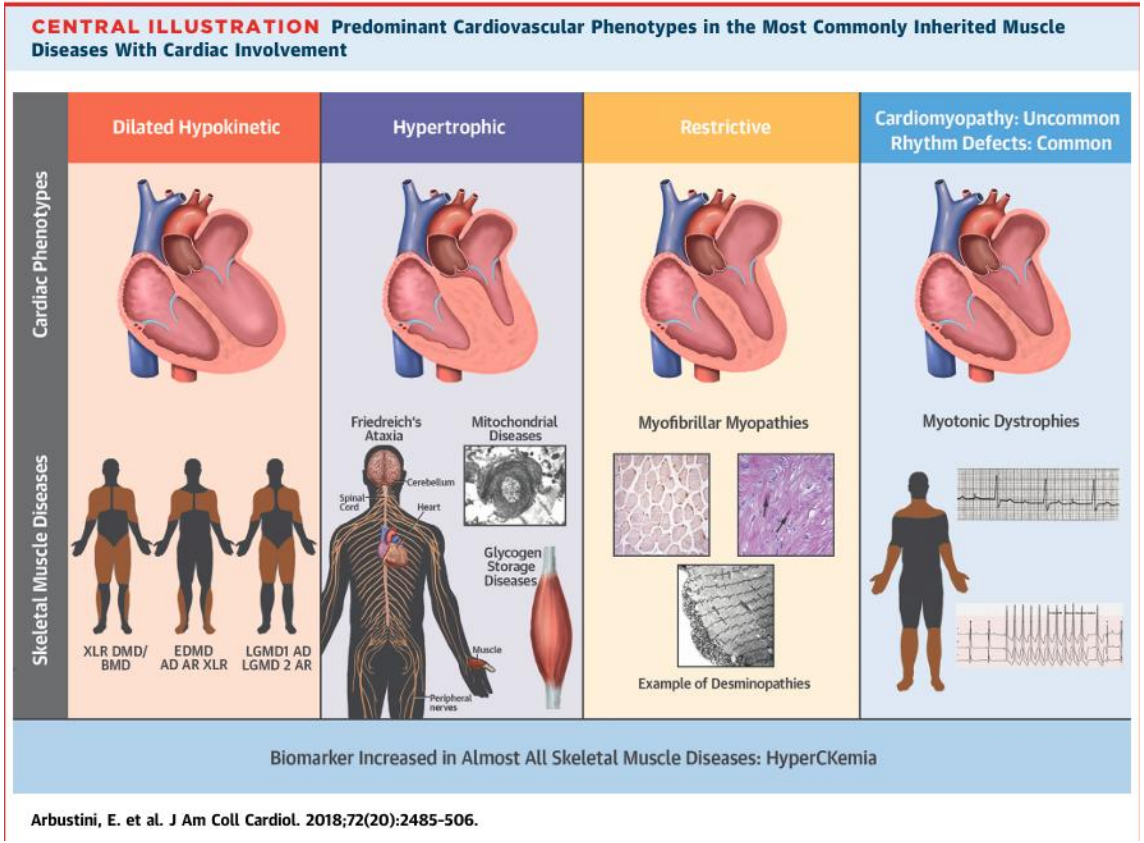


Fig. 1. Pure neuropathic phenotype (a) and additional features (b) in MFN2 mutations. The common features are in blue.

G. Stuppia et al. / Journal of the Neurological Sciences 356 (2015) 7–18

Le cœur, c'est important



Arbustini, E. et al. J Am Coll Cardiol. 2018;72(20):2485-506.

Et puis encore…

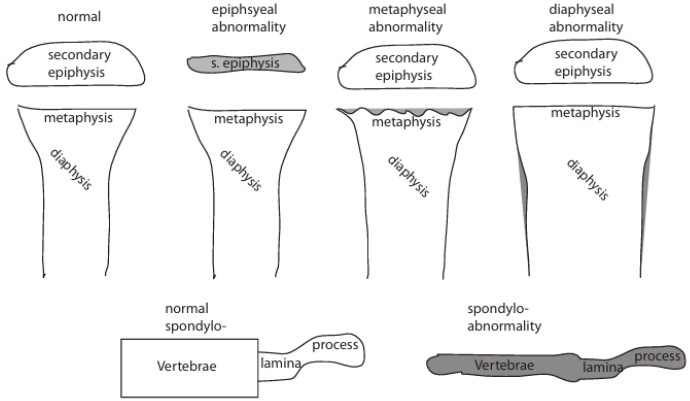
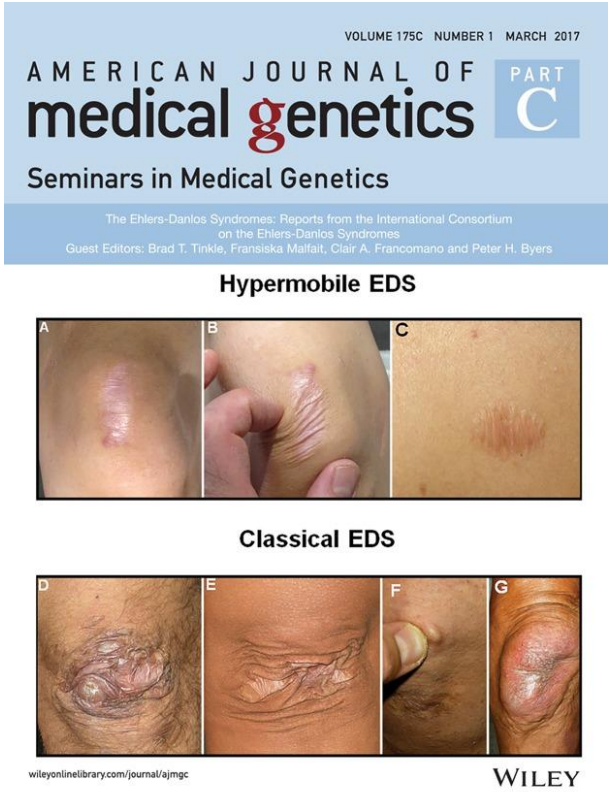
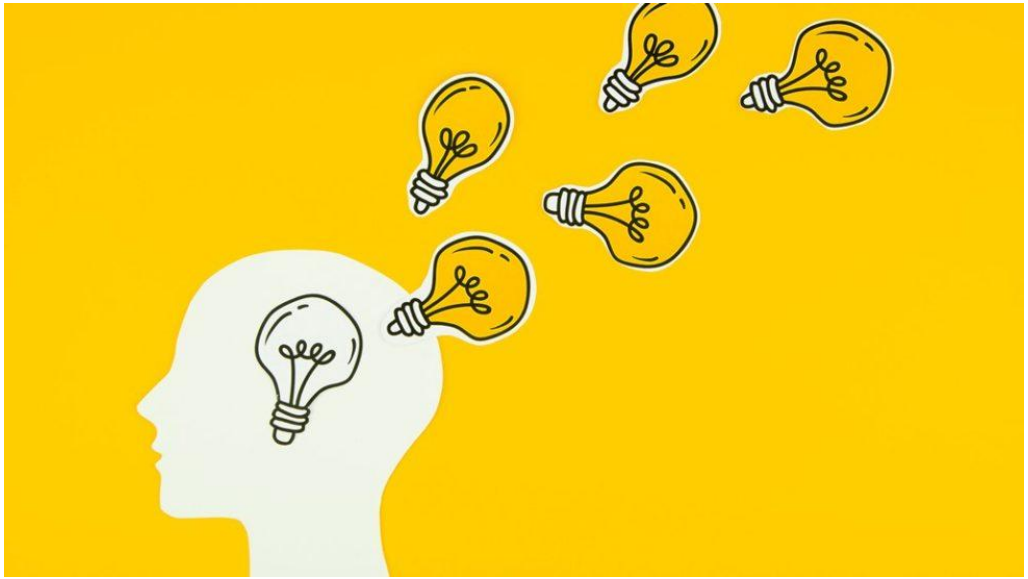


Fig. 2. Cartoon demonstrating the different portions of the appendicular skeleton that manifest radiographic abnormalities that aid in the clinical classification of the skeletal dysplasias.





LES INNOVATIONS

Journal of *Clinical Medicine*

J Clin Med 2022, 11, 6394

MDPI

Review

New Targeted Agents in Myasthenia Gravis and Future Therapeutic Strategies

Daniel Sánchez-Tejerina †, Javier Sotoca †, Arnau Llaurado, Veronica López-Diego, Raul Juntas-Morales and Maria Salvado *

Neuropathology and Applied Neurobiology (2017), **43**, 24–43 doi: 10.1111/nan.12385

Myopathology in times of modern imaging

H. Jungbluth*,†,‡

Review

Gene therapy for neuromuscular disorders: prospects and ethics

Monique M Ryan [1,2]

Arch Dis Child 2022;107:421–426

Drug Discovery Today • Volume 28, Number 3 • March 2023 REVIEWS

ELSEVIER

The myotonic dystrophy type 1 drug development pipeline: 2022 edition

Marta Pascual-Gilabert [1], Ruben Artero [2,3,*], Arturo López-Castel [2,3,*]

[1] Myogem Health Company, S.L, Barcelona, Spain
[2] University Institute for Biotechnology and Biomedicine (BIOTECMED), University of Valencia, Valencia, Spain
[3] Translational Genomics Group, Incliva Biomedical Research Institute, Valencia, Spain

Yiu EM et al. J Neurol Neurosurg Psychiatry 2022;93:530–538.

Review

Clinical practice guideline for the management of paediatric Charcot-Marie-Tooth disease

Next-generation sequencing in neuromuscular diseases

Curr Opin Neurol. 2016 Oct;29(5):527-36

Stephanie Efthymiou[a,b], Andreea Manole[a,b], and Henry Houlden[a,b]

1. Amyotrophie spinale

2. Dystrophinopathies (Duchenne et Becker)

3. Dystrophies musculaires

4. Neuropathies périphériques

5. Myasthénies

Amyotrophie spinale (SMA)

- Werdnig & Hoffmann, 1890
- 1/10’000 naissances (porteur ≈1/50)
- Autosomique récessive
- Gènes *SMN1 et SMN2* sur chr. 5q

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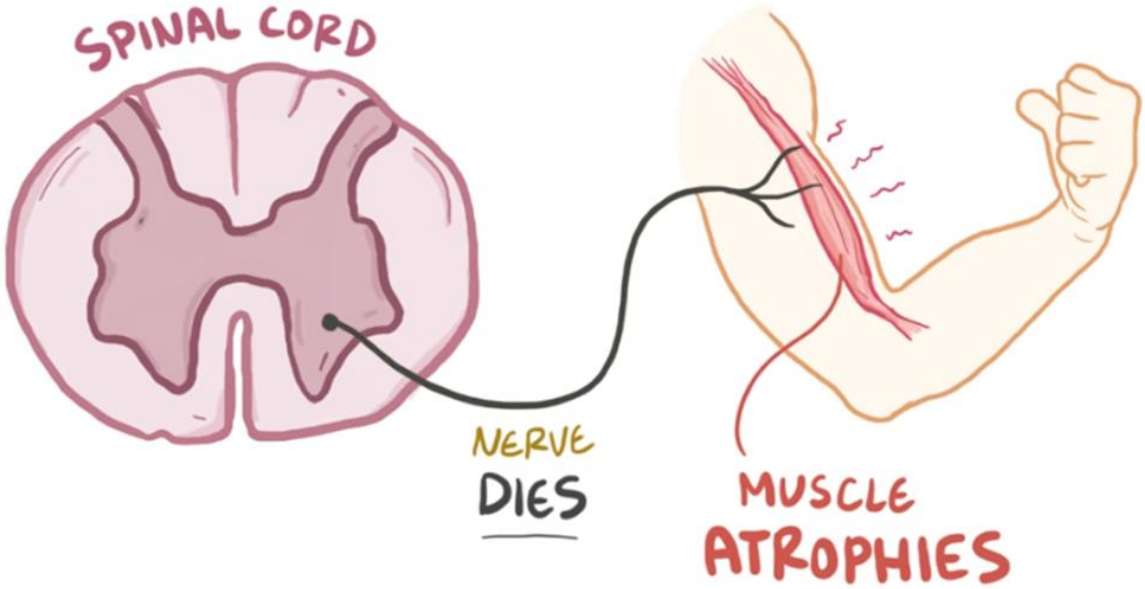
SPINAL MUSCULAR ATROPHY (SMA)

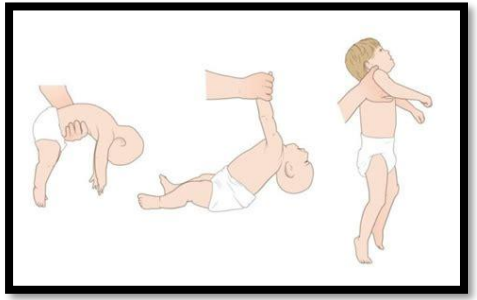
GENETIC DISORDER

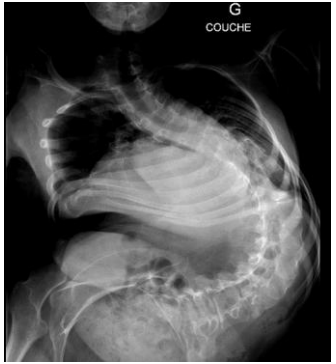


Osmosis.org

- **Faiblesse progressive symétrique**
  - Gradient proximo-distal
  - MI > MS
- Perte des réflexes ostéotendineux
- Fasciculations linguales
- «Tremor» (pseudominimyoclonus)

- Mauvaise croissance
- RGO
- **Scoliose**
- Luxation hanches





- Difficultés oromotrices / déglutition
- **Trouble / insuffisance respiratoire**
- Fatigue

- Pas de problème cardiaque (en général)
- Intelligence normale (en général)

«Continuum» des phénotypes

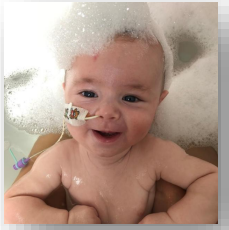


TABLE 1. Classification and Subtypes of Spinal Muscular Atrophy

Type	Age of Onset	Maximal Motor Milestone	Motor Ability and Additional Features	Prognosis[c]
SMA 0	Before birth	None	Severe hypotonia; unable to sit or roll[a]	Respiratory insufficiency at birth; death within weeks
SMA I	2 weeks (Ia) 3 months (Ib) 6 months (Ic)	None	Severe hypotonia; unable to sit or roll[b]	Death/ventilation by 2 years
SMA II	6 to 18 months	Sitting	Proximal weakness; unable to walk independently	Survival into adulthood
SMA III	<3 years (IIIa) >3 years (IIIb) >12 years (IIIc)	Walking	May lose ability to walk	Normal life span
SMA IV	>30 years or 10 to 30 years	Normal	Mild motor Impairment	Normal life span

care.togetherinsma.eu

60%

30%

10%

Non-Sitter

Sitter

Walker

Farrar et al., Ann Neurol, 2017

En Suisse

Table 2. Total number of patients alive[a] by neuromuscular disorder and age (31.12.2023).

Disease	Age 0-20	Age 20-65	Total
DMD-Duchenne	117	53	**170**
BMD-Becker	19	21	**40**
IMD-Intermediate	4	≤3	**6[b]**
SMA type 1	28	≤3	**30[b]**
SMA type 2	36	33	**69**
SMA type 3	13	53	**66**
SMA unspecified[c]	≤3	0	**3[b]**
LAMA2-RMD	15	≤3	**18[b]**
COL6-RD	6	0	**6**
Total	**241[b]**	**167**	**408**

DMD: Duchenne Muscular Dystrophy; BMD: Becker Muscular Dystrophy; IMD: Intermediate form; SMA1-3: Spinal Muscular Atrophy type 1-3; LAMA2-RMD: LAMA2-related Muscular Dystrophy, COL6-RD: Collagen-VI-related dystrophy. To ensure patient confidentiality we mask small numbers with "≤3".

[a] Not reported as deceased; [b] Approximate value to ensure patient confidentiality; [c] unspecified SMA type, e.g. pre-symptomatic start of treatment.

https://www.swiss-reg-nmd.ch/wp-content/uploads/sites/17/Swiss-Reg-NMD_2023_Annual_Report_webpage.pdf

Fig. 2. Multidisciplinary approach.

Available online at www.sciencedirect.com
ScienceDirect
ELSEVIER
Neuromuscular Disorders ■■ (2017) ■■–■■
www.elsevier.com/locate/nmd

Diagnosis and management of spinal muscular atrophy: Part 1: Recommendations for diagnosis, rehabilitation, orthopedic and nutritional care

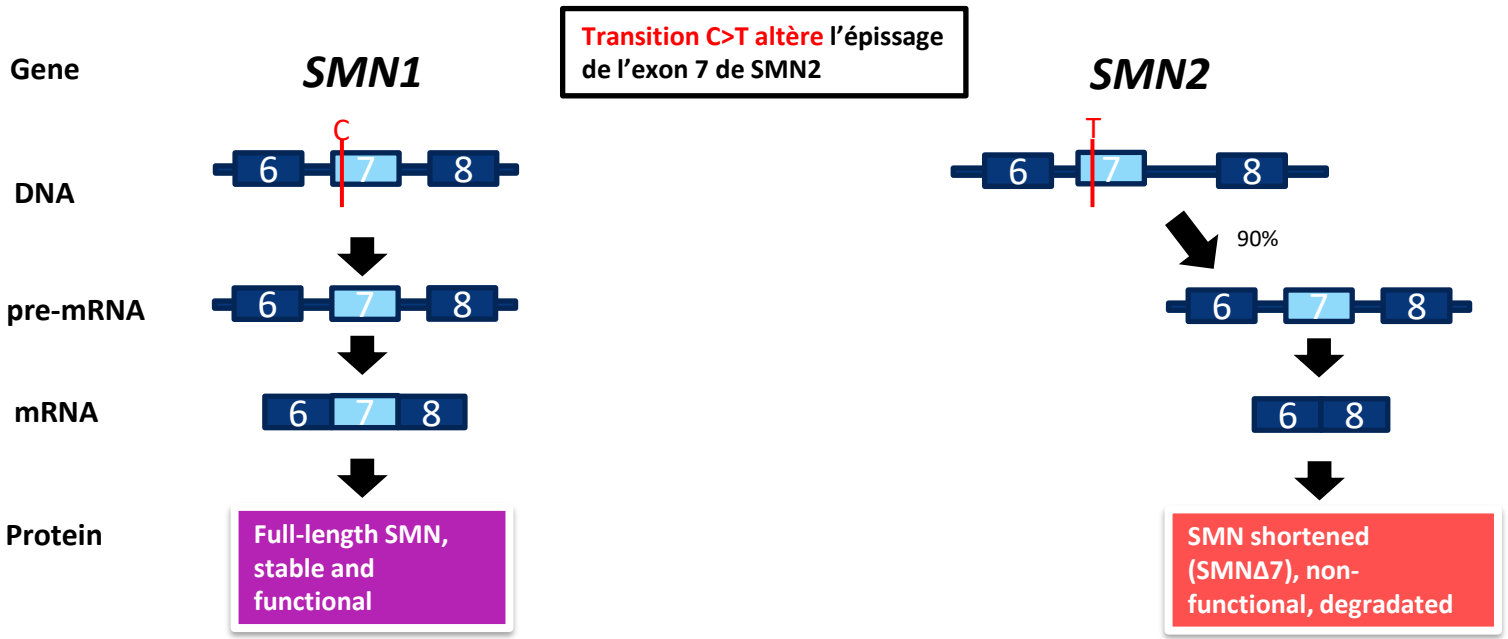
Eugenio Mercuri [a,b,l,*], Richard S. Finkel [c,l], Francesco Muntoni [d], Brunhilde Wirth [e], Jacqueline Montes [f], Marion Main [d], Elena S. Mazzone [a,b], Michael Vitale [g], Brian Snyder [h], Susana Quijano-Roy [i,j], Enrico Bertini [k], Rebecca Hurst Davis [l], Oscar H. Meyer [m], Anita K. Simonds [n], Mary K. Schroth [o], Robert J. Graham [p], Janbernd Kirschner [q], Susan T. Iannaccone [r], Thomas O. Crawford [s], Simon Woods [t], Ying Qian [u], Thomas Sejersen [v] for the SMA Care Group

Diagnosis and management of spinal muscular atrophy: Part 2: Pulmonary and acute care; medications, supplements and immunizations; other organ systems; and ethics

Richard S. Finkel [a,l], Eugenio Mercuri [b,l,*], Oscar H. Meyer [c], Anita K. Simonds [d], Mary K. Schroth [e], Robert J. Graham [f], Janbernd Kirschner [g], Susan T. Iannaccone [h], Thomas O. Crawford [i], Simon Woods [j], Francesco Muntoni [k], Brunhilde Wirth [l], Jacqueline Montes [m], Marion Main [k], Elena S. Mazzone [b], Michael Vitale [n], Brian Snyder [o], Susana Quijano-Roy [p], Enrico Bertini [q], Rebecca Hurst Davis [r], Ying Qian [s], Thomas Sejersen [t] for the SMA Care group

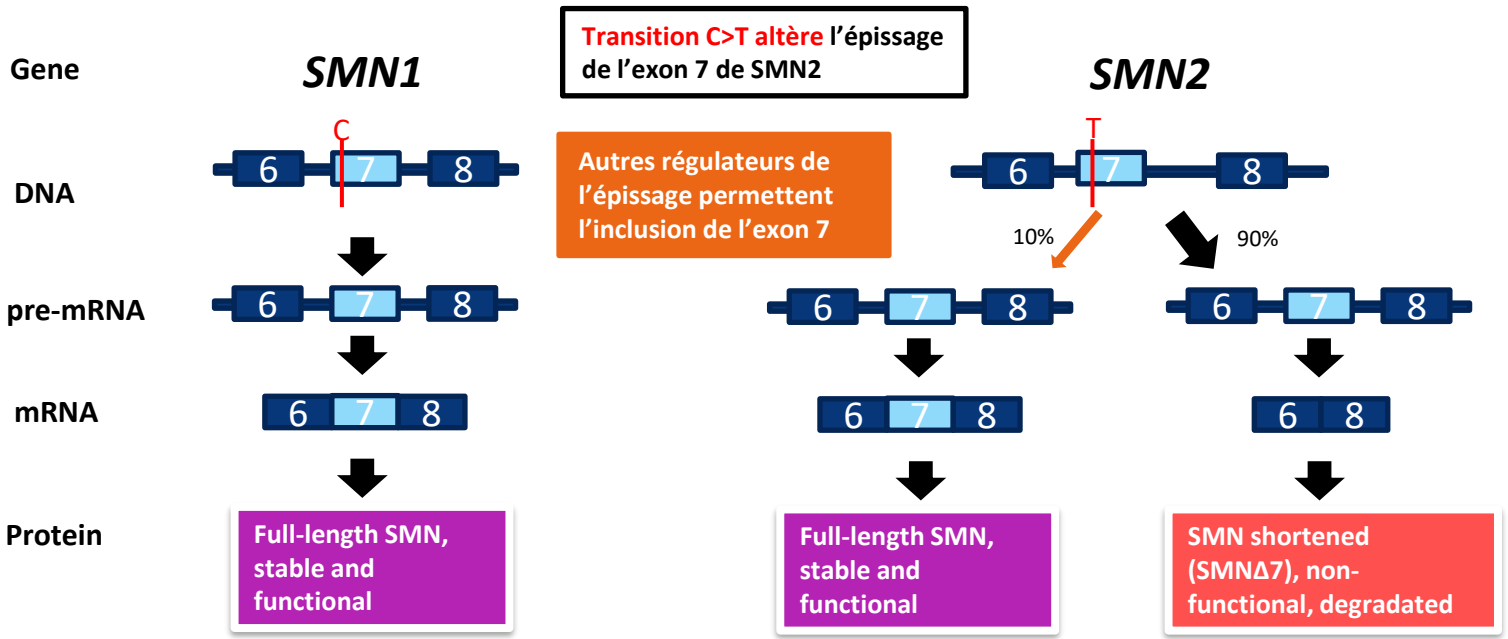
Adapted from Mercuri et al. Diagnosis and management of spinal muscular atrophy: Part 1; Neuromuscul Disord 2018 Feb;28(2):103-115
& Finkel RS *et al.* Diagnosis and management of spinal muscular atrophy: Part 2; *Neuromuscular Disorders 28 (2018) 197–207*

PATHOMÉCANISME & GÉNÉTIQUE



mRNA = messanger RNA

Inspired by Messina S et Sframeli M. J Clin Med. 2020 Jul 13;9(7):2222



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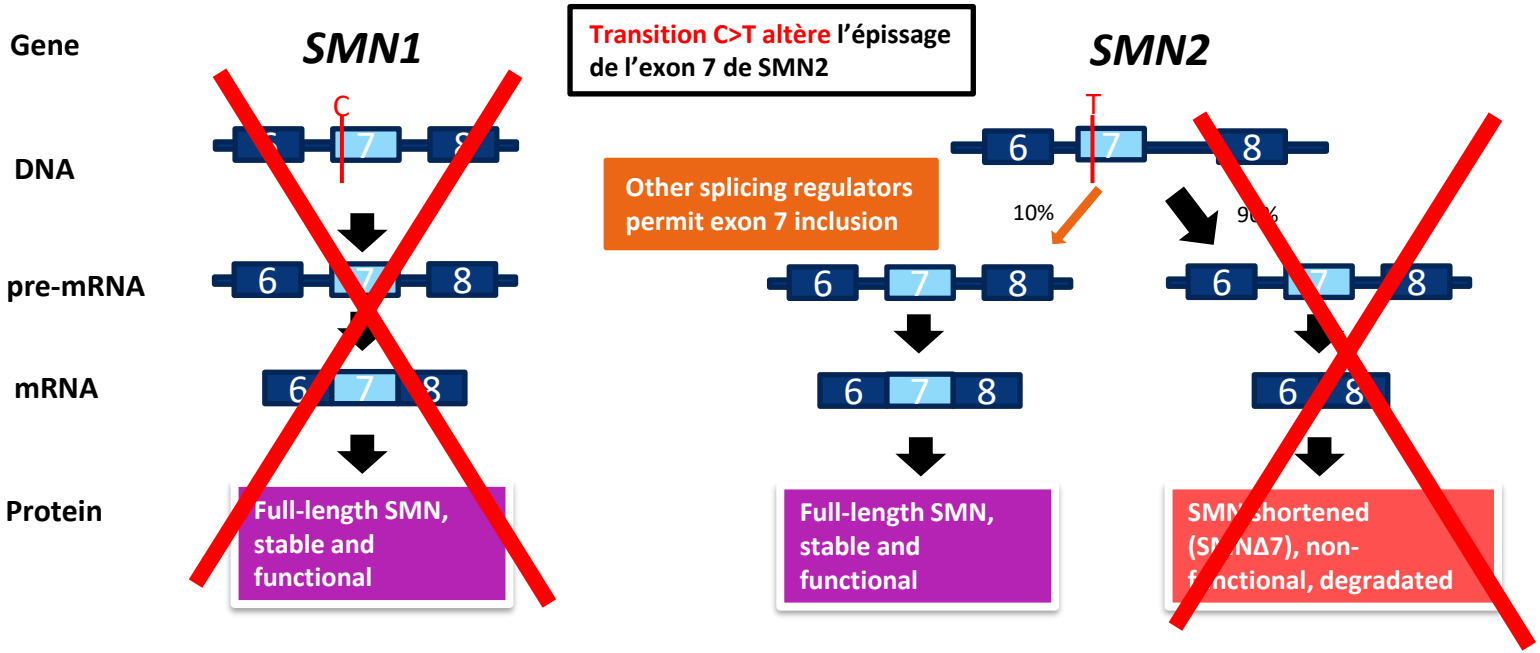
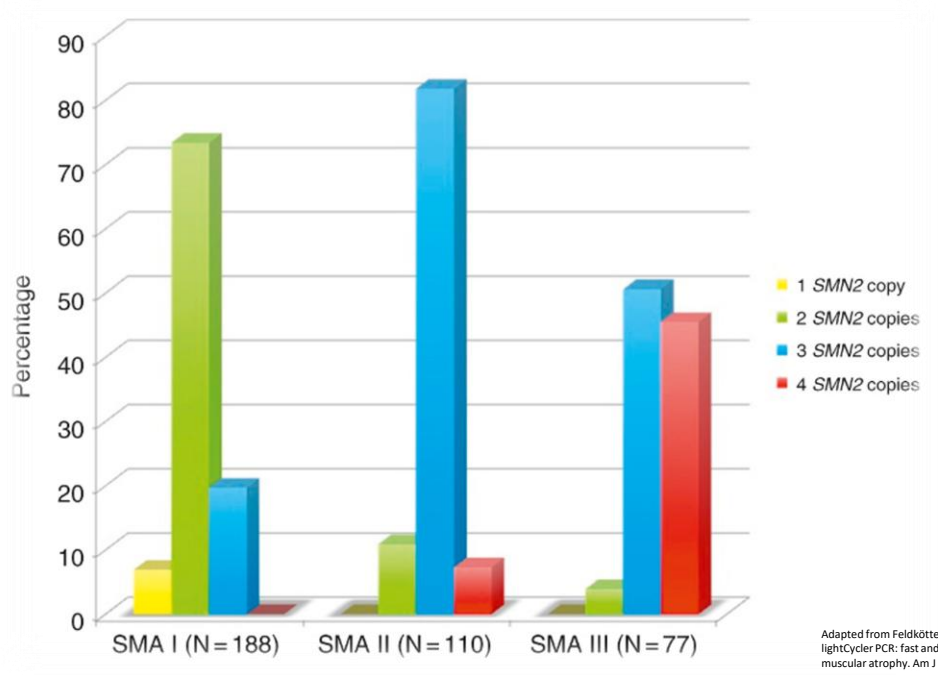


mRNA = messanger RNA

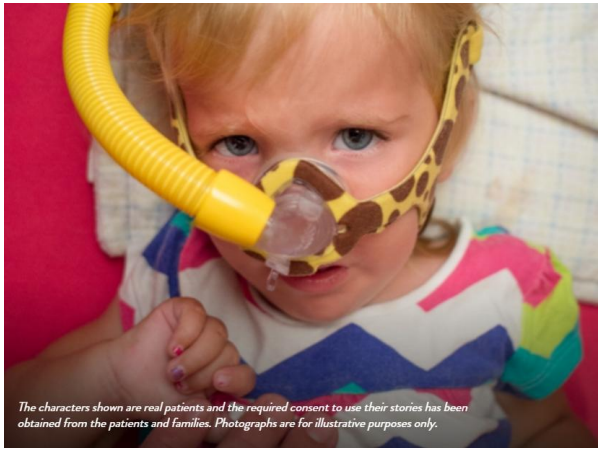
Inspired by Messina S et Sframeli M. J Clin Med. 2020 Jul 13;9(7):2222

Les copies de *SMN2*

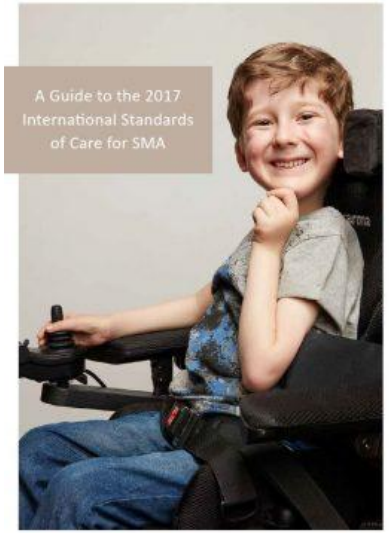
Forte corrélation avec la sévérité de la maladie



Adapted from Feldkötter et al. Quantitative analyses of SMN1 and SMN2 based on real-time lightCycler PCR: fast and highly reliable carrier testing and prediction of severity of spinal muscular atrophy. Am J Hum Genet 2002 Feb;70(2):358-68

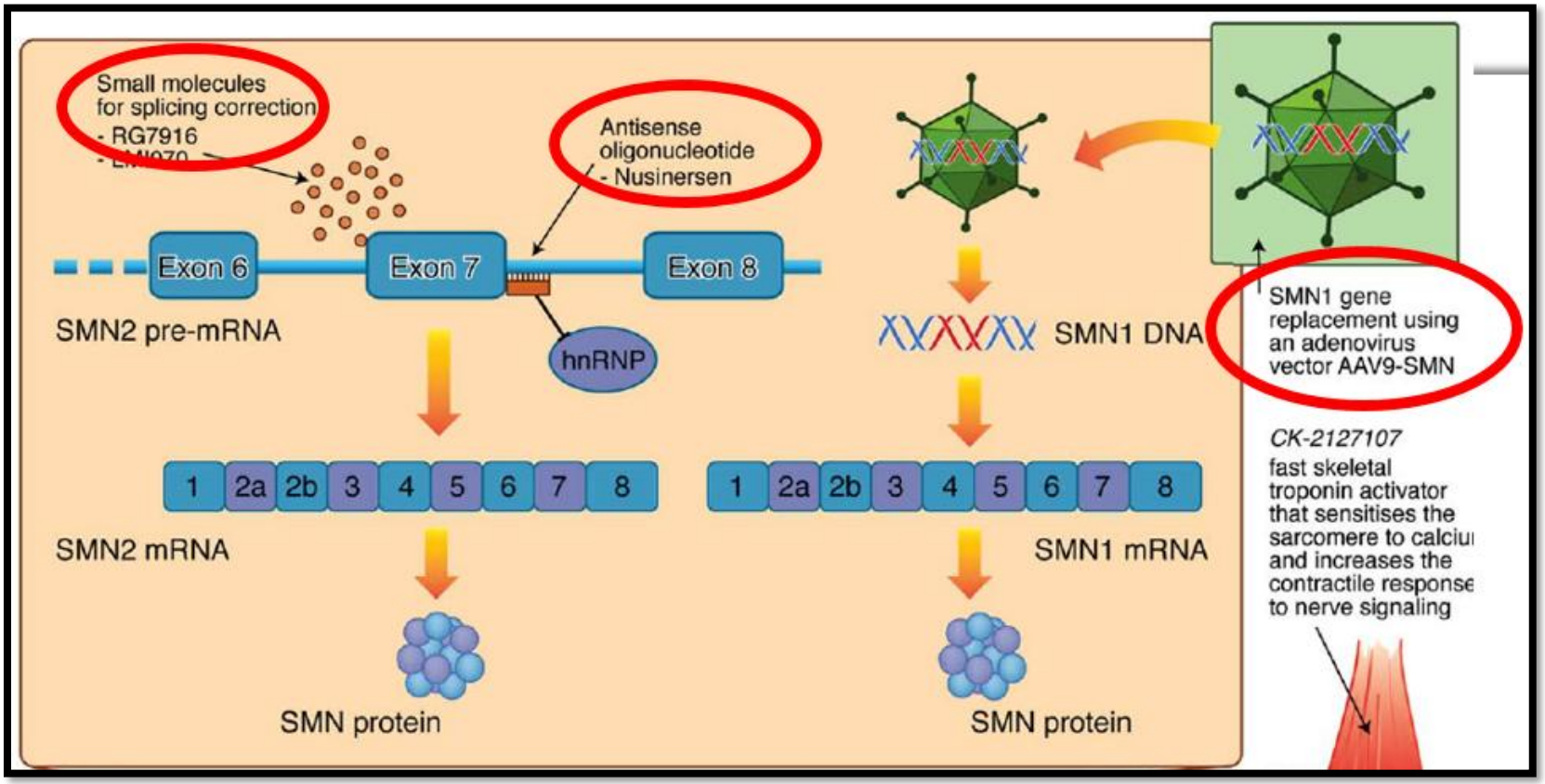


https://care.togetherinsma.eu/en/home/sma-in-infants-and-children/living-with-sma.html



https://treat-nmd.org/care-overview/2017-standards-of-care-for-spinal-muscular-atrophy-sma/the-guide-to-the-2017-international-standards-of-care-for-sma/

NOUVELLES THÉRAPIES MÉDICAMENTEUSES



Farrar AM et al. Ann Neurol. 2017 Mar;81(3):355-368

Survival Motor Neuron–Directed Treatment Pathways for Patients With Spinal Muscular Atrophy

TABLE 12-3

Drug	Date of FDA approval, age group	Mechanism of action	Pivotal trials (age range inclusion)	Dose, route of administration, and frequency of maintenance	Main adverse effects
Nusinersen	December 2016, all ages	Antisense oligonucleotide splicing modifier of *SMN2*	ENDEAR[28] (1 week to 7 months), CHERISH[29] (2-12 years), NURTURE[17] (0-6 weeks)	12 mg; intrathecal; 4 loading doses over 2 months, then maintenance every 4 months	Adverse effects related to the lumbar puncture, unknown risk of teratogenicity
Onasemnogene abeparvovec	May 2019, <2 years	*SMN1* gene replacement via AAV9 vector	STR1VE[65,66] (<7 months), SPR1NT[32,33] (0-6 weeks)	1.1×10^{14} vector genomes (vg)/kg patient body weight, IV single infusion	Thrombotic microangiopathy, liver toxicity and acute liver failure leading to death, thrombocytopenia
Risdiplam	August 2020, May 2022,[a] all ages	Small molecule splicing modifier of *SMN2*	FIREFISH[67] (0-7 months), SUNFISH[31] (2-25 years), Rainbowfish (0-6 weeks)	<2 months: 0.15 mg/kg 2 months to <2 years: 0.20 mg/kg ≥2 years and <20 kg: 0.25 mg/kg ≥2 years and ≥20 kg: 5 mg Orally, once daily after a meal	Potential teratogenicity, photosensitivity, diarrhea

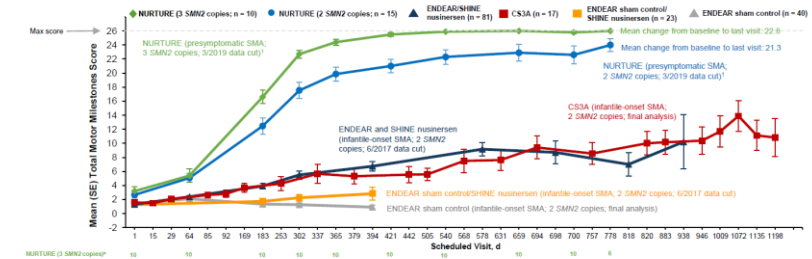
FDA = US Food and Drug Administration.
[a] FDA approved in May 2022 for children younger than 2 months old.

D. Jacquier

Oskoui M & Servais L. Continuum 2023 Oct 1;29(5):1564-1584

The Greatest Improvements in HINE-2 Total Motor Milestone Scores Were Observed in Presymptomatic Infants Treated With Nusinersen

- In all NURTURE participants, mean (SD) at last visit and mean (SD) change from baseline to last visit in HINE-2 total scores were 24.8 (2.74) and 21.9 (2.55), respectively



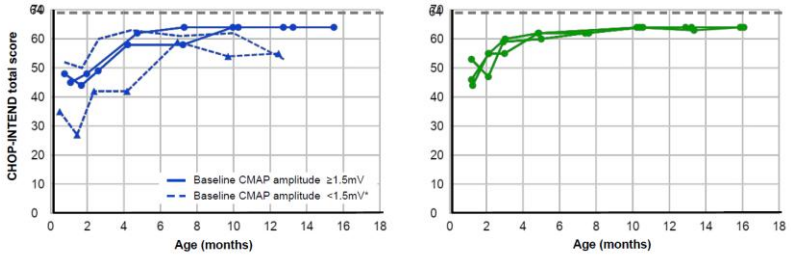
- The ability of infants to suck and swallow was also assessed using HINE-1 neurological assessment
  - At the last observed visit (up to and including Day 778), all NURTURE participants had the ability to suck and swallow, and 22 of 25 achieved the maximum score of 3 (good sucking and swallowing) on the HINE-1

ITT = intention to treat; HINE-1 = Hammersmith Infant Neurological Examination Section 1
NURTURE study interim analysis data cutoff date: 29 March 2019; ENDEAR/SHINE integrated analysis data cutoff date: 30 June 2017. [a]HINE-2 was assessed in NURTURE participants up until the Day 778 study visit. [b]CS3A end-of-study data for the cohort of infants with 2 SMN2 copies. [c]ENDEAR participants with 2 SMN2 copies in the ITT population. ENDEAR data were windowed into intervals based on time from baseline. Data are reported from the first interim data cut of SHINE. For each study, n ≥ 5 are plotted. 1. De Vivo DC, et al; NURTURE Study Group. *Neuromuscul Disord*. 2019;29(11):842-856.

9

Most infants treated with risdiplam for ≥12 months (n=7) achieved the maximum CHOP-INTEND score

Roche

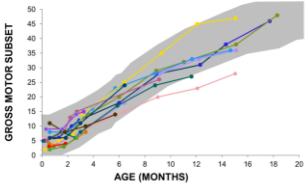


*The two infants with baseline CMAP <1.5 mV had baseline values of 0.6 mV (square symbols) and 0.46 mV (triangles).
At the data cut-off, only seven infants had received treatment with risdiplam for ≥12 months and were included in this analysis.
Data cut-off: 1 Jul 2021.
CHOP-INTEND, Children's Hospital of Philadelphia Infant Test of Neuromuscular Disorders; CMAP, compound muscle action potential amplitude; mV, millivolt; SMN, survival of motor neuron.

64

SPR1NT (patients with two copies of *SMN2*): Bayley-III gross motor score

Increases in mean Bayley-III gross and fine motor score in patients with two copies of *SMN2*[1]



- **7 of 14 (50%)** have **gross motor performance** similar to same-age children
- **14 of 14 (100%)** have **fine motor performance** similar to same-age children

Data cut-off date: December 31, 2019. Bayley-III is an assessment tool of developmental function in children 1–42 months old[2]. Each line in the graph represents data from an individual patient. The gray shaded area denotes the normal range of raw Bayley-III Gross Motor scores (mean ± 2 × SD)[2]. Bayley-III, Bayley Scales of Infant and Toddler Development, Version 3; SD, standard deviation; SMN, survival motor neuron.

1. Novartis Gene Therapies. Data on file, 2020; 2. Alberts CA, Grieve AJ. *J Psychoeduc Assess* 2007;25:180–190.

23 Kindly provided by Dr H. Fischer - Novartis Gene Therapy

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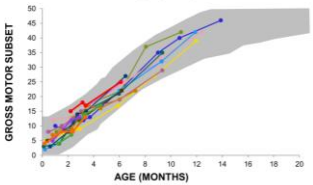
SPR1NT (patients with three copies of *SMN2*): Bayley-III gross motor score

Increases in mean Bayley-III gross and fine motor score in patients with three copies of *SMN2*[1]



- **15 of 15 (100%)** have **gross motor performance** similar to same-age children
- **14 of 15 (93%)** have **fine motor performance** similar to same-age children

Data cut-off date: December 31, 2019. Bayley-III is an assessment tool of developmental function in children 1–42 months old[2]. Each line in the graph represents data from an individual patient. The gray shaded area denotes the normal range of raw Bayley-III Gross Motor scores mean ± 2 × SD)[2]. Bayley-III, Bayley Scales of Infant and Toddler Development, Version 3; SD, standard deviation; SMN, survival motor neuron.

1. Novartis Gene Therapies. Data on file, 2020; 2. Bayley N. *J Psychoeduc Assess* 2007;25:180–198.

24 Kindly provided by Dr H. Fischer - Novartis Gene Therapy

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Pediatric Drugs
https://doi.org/10.1007/s40272-022-00529-8
Paediatr Drugs. 2022 Aug 27

REVIEW ARTICLE

Pharmacotherapy for Spinal Muscular Atrophy in Babies and Children: A Review of Approved and Experimental Therapies

Claudia A. Chiriboga[1]

Some key points:

- These 3 DMT are effective in treating SMA.
- No studies have established superior efficacy of any one DMT.
- The earlier the treatment, the better the clinical response.
- Presymptomatic treatment results in the best clinical response.

Nusinersen (Spinraza®)

- Autorisé dès 2017
- Si ≥ 2 copies du gène *SMN2*
  - Aussi chez les patient.es présymptomatiques

Risdiplam (Evrysdi®)

- Autorisé dès 2021
- Si ≥ 2 copies du gène *SMN2*
  - Aussi chez les patient.es présymptomatiques

Onasemnogène abeparvovec (Zolgensma®)

- Autorisé dès 2021
- si entre 1-3 copies du gène *SMN2* et <2 ans d'âge
  - Aussi chez les patient.es présymptomatiques

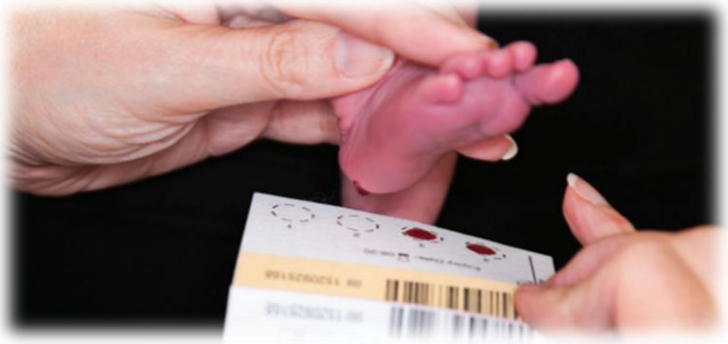
Office fédéral des assurances sociales
Fonction fédérale suisse

Assurance-invalidité

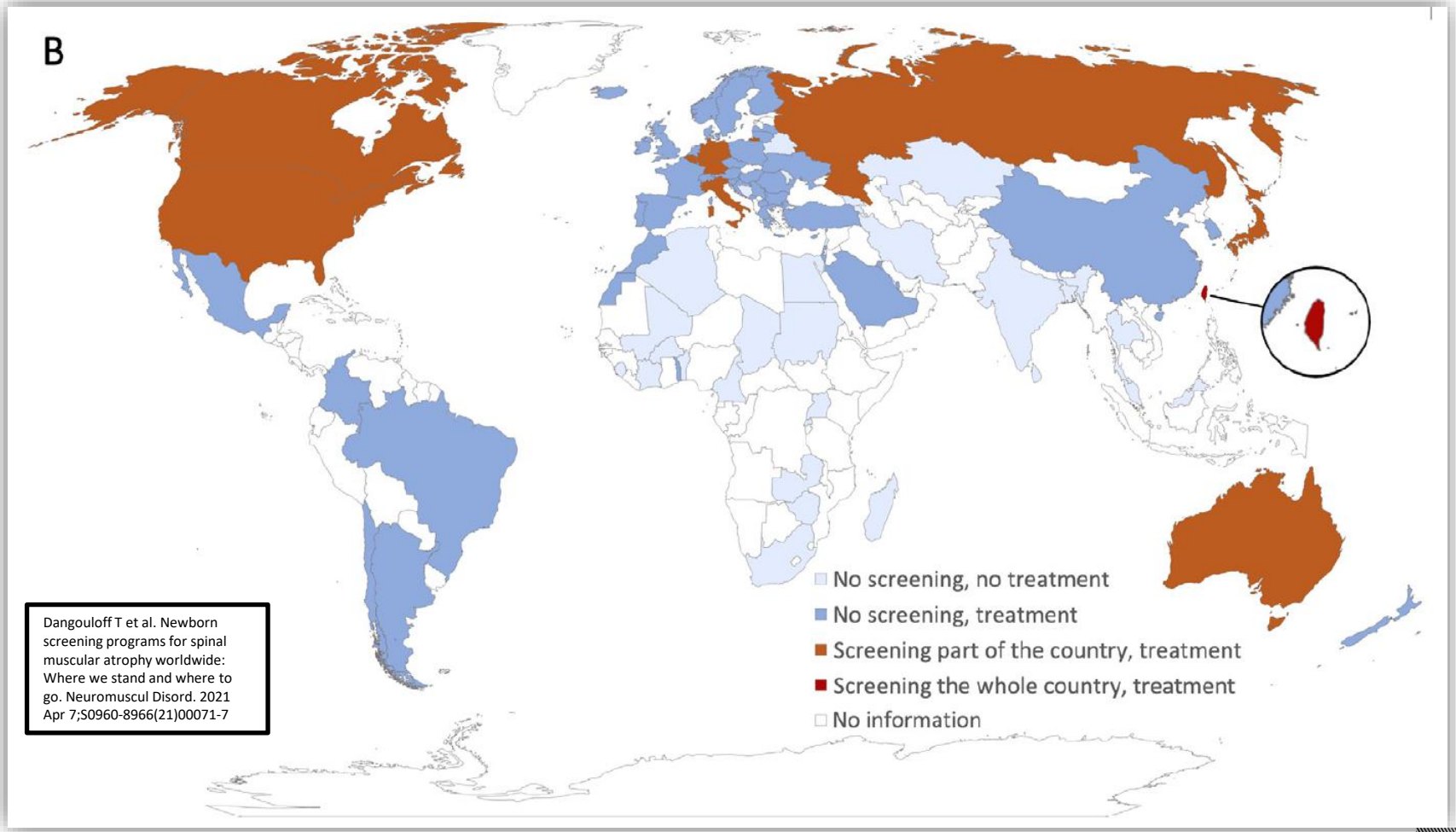
swissmedic

Office fédéral de la santé publique
Fonction fédérale suisse

Assurance-maladie



DÉPISTAGE NÉONATAL



Dangouloff T et al. Newborn screening programs for spinal muscular atrophy worldwide: Where we stand and where to go. Neuromuscul Disord. 2021 Apr 7;S0960-8966(21)00071-7

ASRIMM

muskelkrank & lebensstark

Neugeborenen-Screening
Dépistage Néonatal
Screening Neonatale
Screening dal Novnaschì

M G R Associazione Malattie Genetiche Rare Svizzera italiana

Eidgenössische Kommission für genetische Untersuchungen beim Menschen (GUMEK)

AHV AVS AI IV

Bundesamt für Gesundheit BAG
Sekretariat EAMGK
Ausschuss Analysen

BAG OFSP UFSP

NEK CNE

- Janvier 2020: Début projet
- 15.12.2023: Autorisation CH
- 01.03.2024: Début dépistage (financements externes)
- 01.07.2024: Prise en charge par les assurances-maladies

Biogen

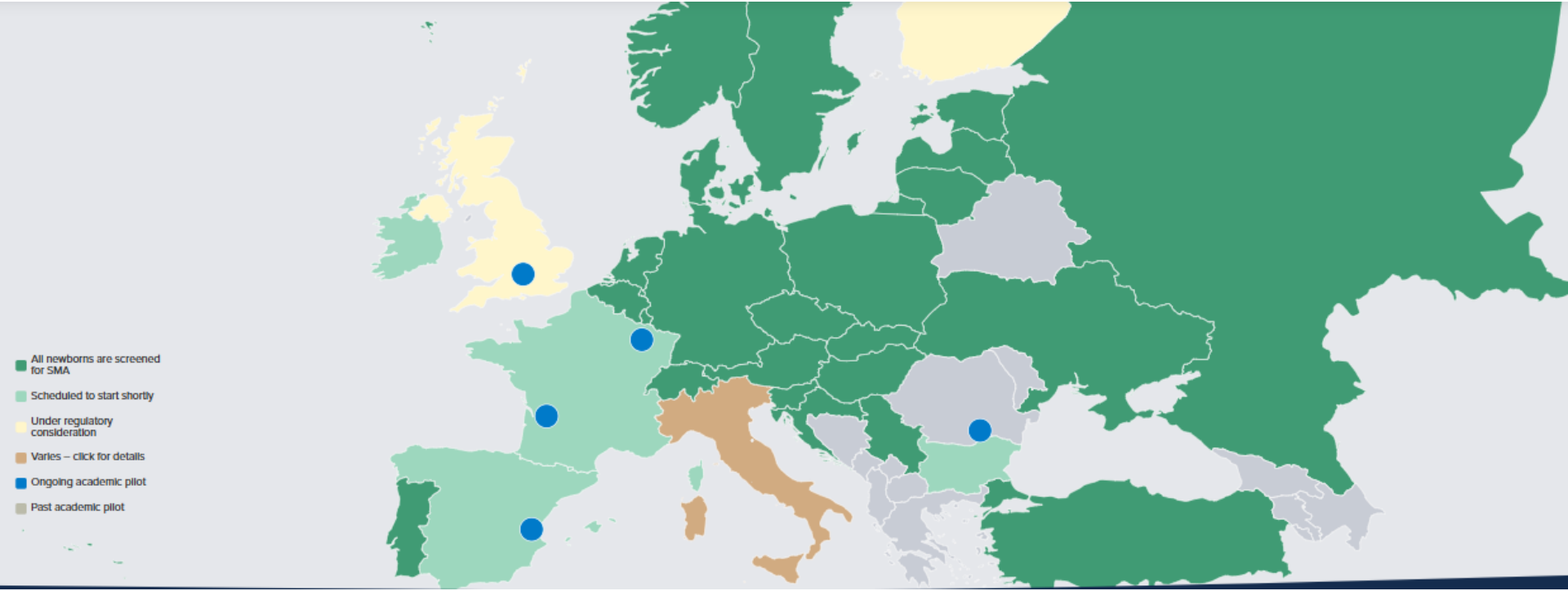
Roche

NOVARTIS

canton de vaud

CHUV

NBS Alliance | Home (sma-screening-alliance.org)



Capture du 31.03.2025

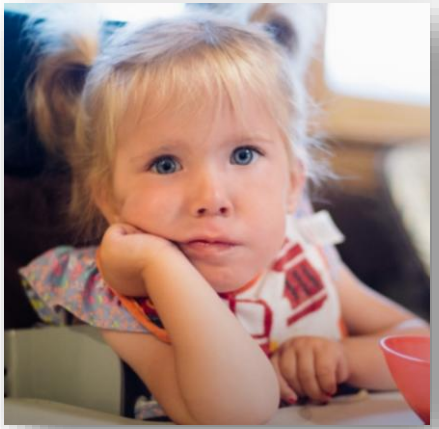
Labo NBS

SPNMC

SPNMC proposant les 3 DMT

Swiss pediatric neuromuscular centers

- Etablis sur mandat de la Société suisse de neuropédiatrie
- Travail en réseau
- Membres de Myosuisse
  - https://www.muskelgesellschaft.ch/myosuisse/
- Reconnu par la kosek
  - https://www.kosekschweiz.ch/fr/kosek



care.togetherinsma.eu

smauk.org.uk

ASYMPTOMATIQUE? VRAIMENT?

JAMA Pediatrics | Original Investigation

Clinical Effectiveness of Newborn Screening for Spinal Muscular Atrophy

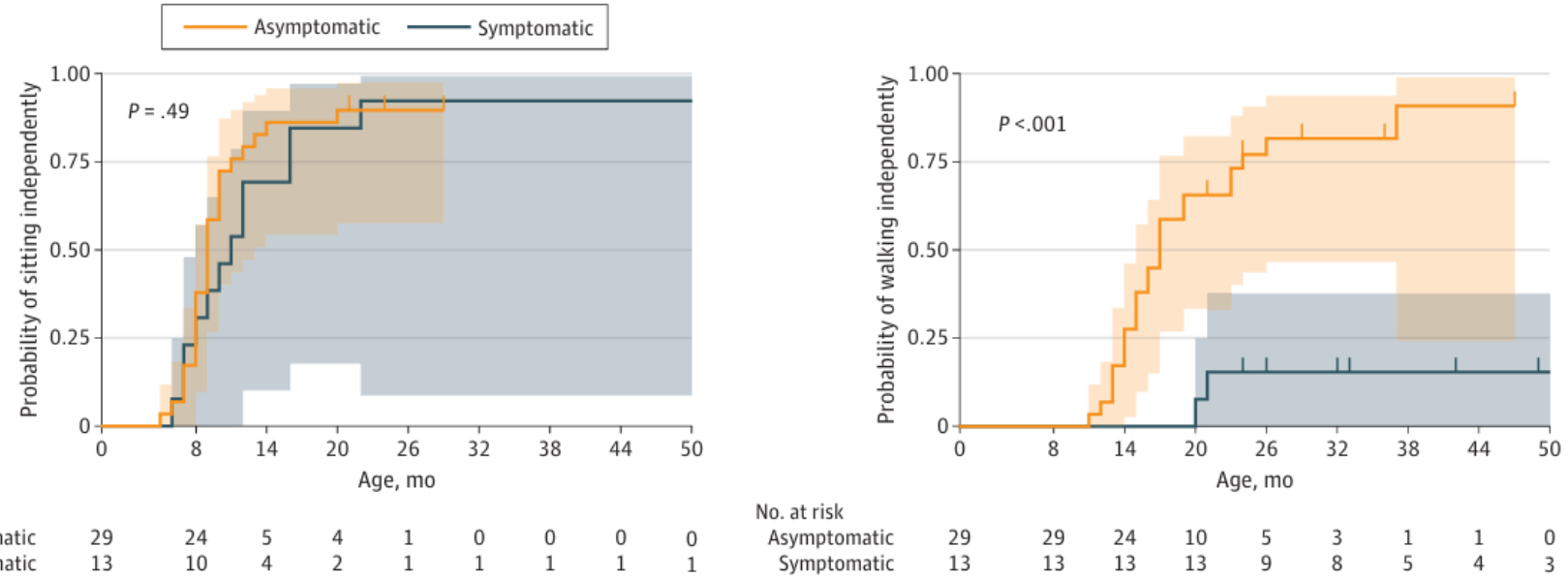
A Nonrandomized Controlled Trial

Schwartz O. et al. JAMA Pediatr. 2024 Jun 1;178(6):540-547

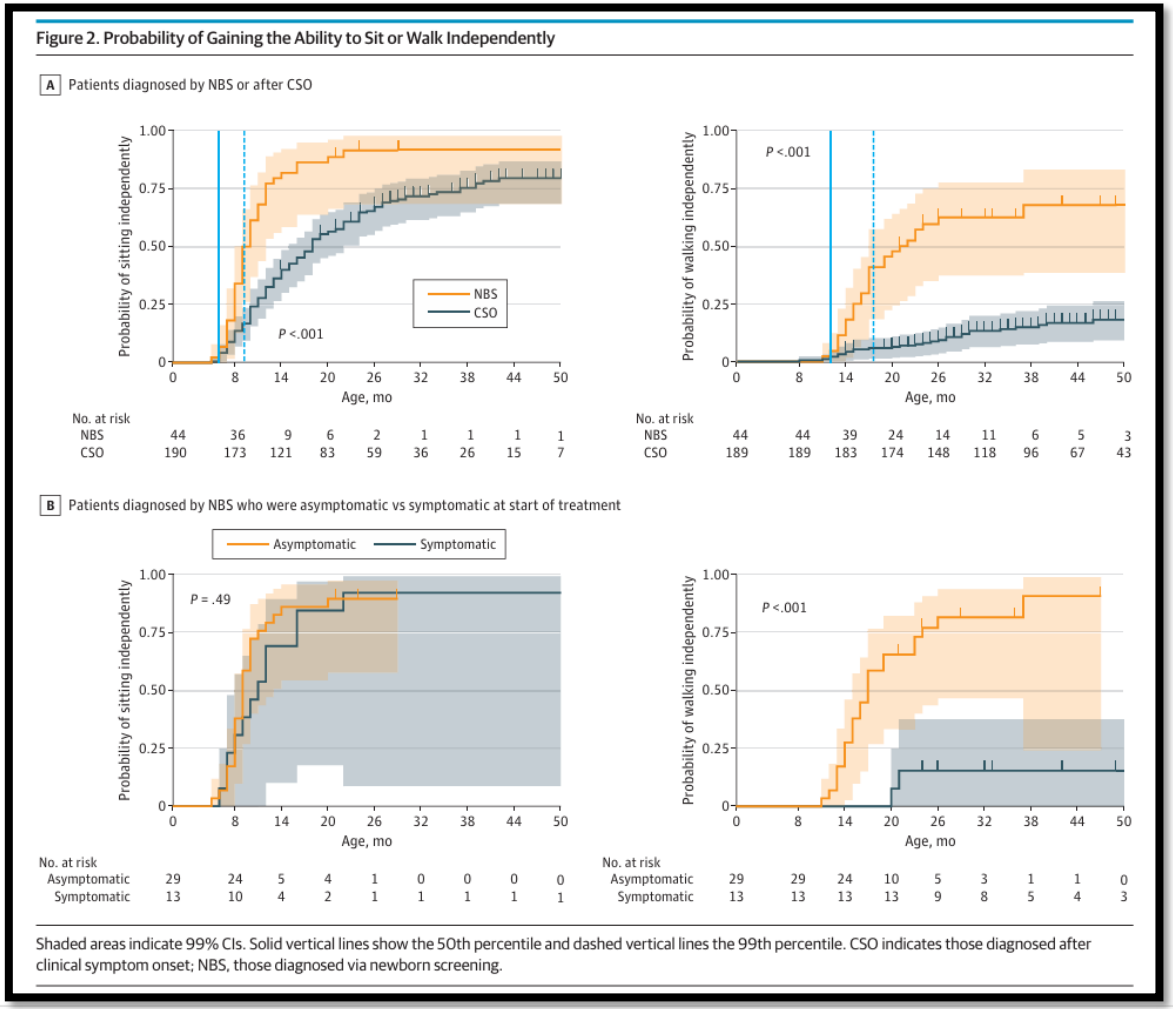
Figure 2.

A Patie

B Patients diagnosed by NBS who were asymptomatic vs symptomatic at start of treatment

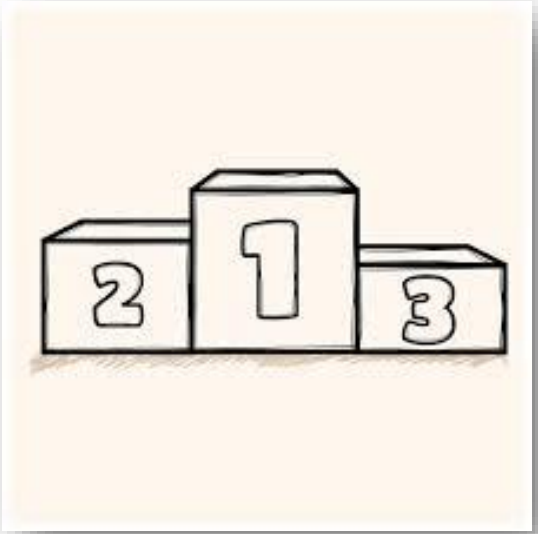


Shaded areas indicate 99% CIs. Solid vertical lines show the 50th percentile and dashed vertical lines the 99th percentile. CSO indicates those diagnosed after clinical symptom onset; NBS, those diagnosed via newborn screening.

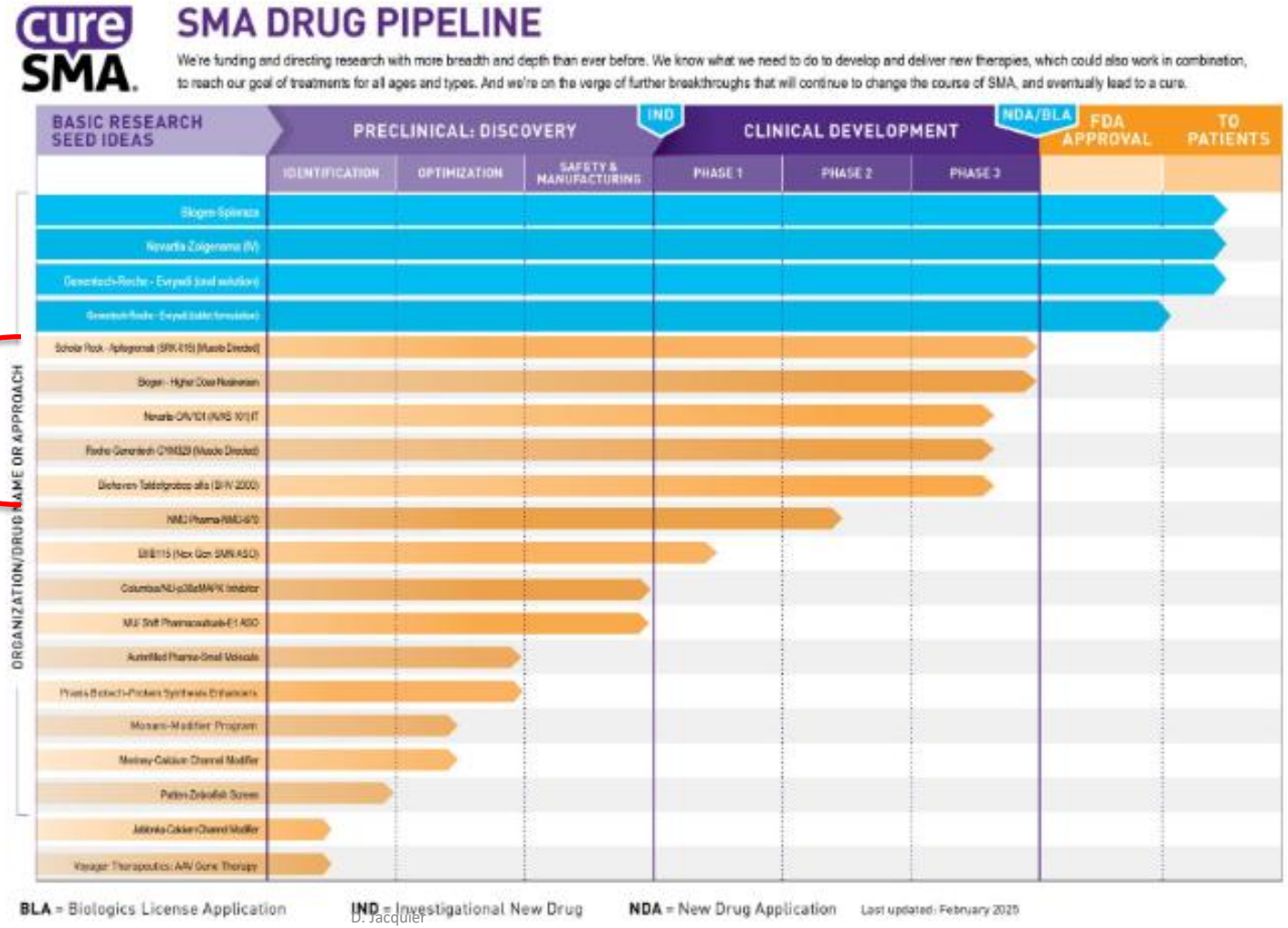


Clinical Effectiveness of Newborn Screening for Spinal Muscular Atrophy
JAMA Pediatr. 2024;178(6):540-547


WHAT'S
NEXT
2
0


2
1
3

- Apitegromab
- Nusinersen «+»
- OA en IT
- GYM329
- Taldefgrobep alfa



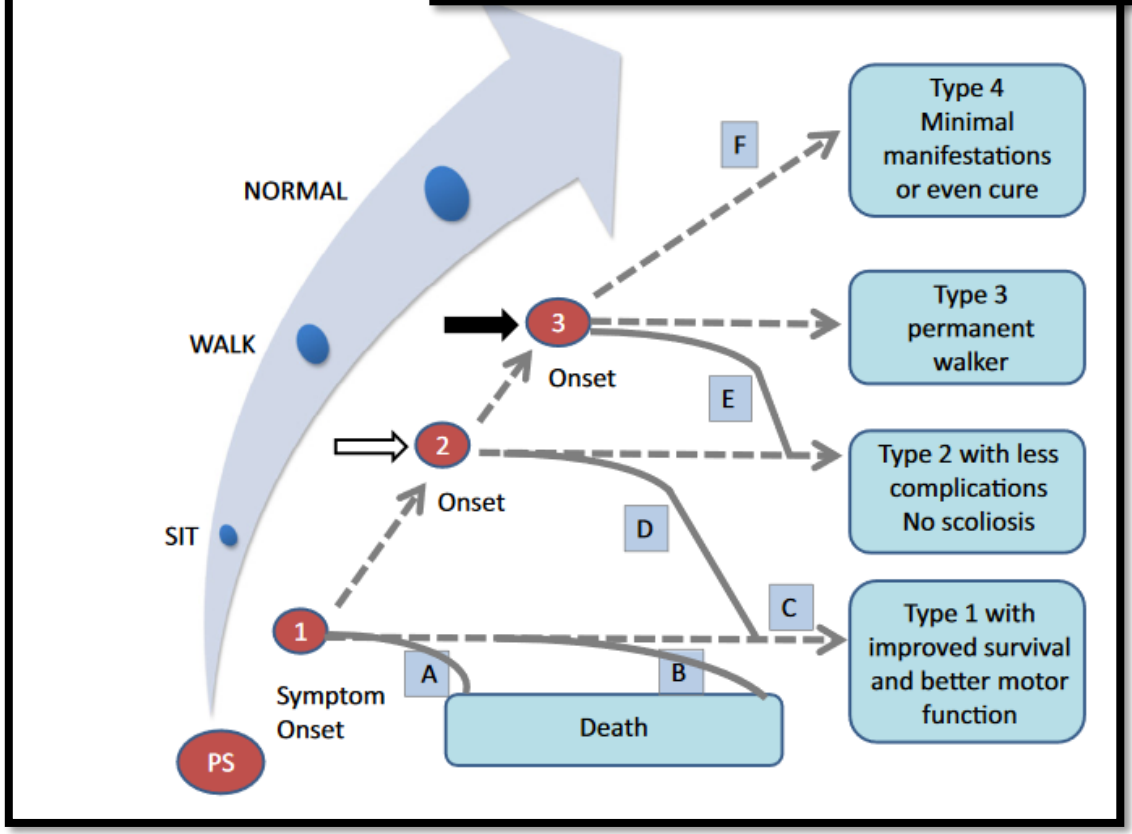
https://www.curesma.org/sma-drug-pipeline/

Swiss-Reg-NMD

Registre suisse des maladies neuromusculaires

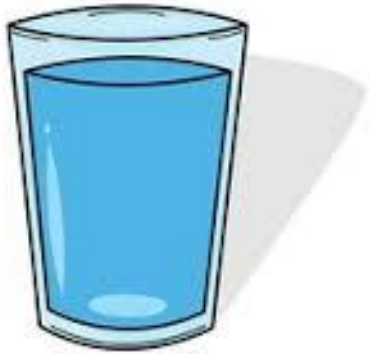
Letter to the Editor

The emerging spectrum of neurodevelopmental comorbidities in early-onset Spinal Muscular Atrophy



European Journal of Paediatric Neurology 48 (2024) 67–68

Tizzano EF, Finkel RS.
Neuromusc Dis 2017 Oct; 27(10):883-889



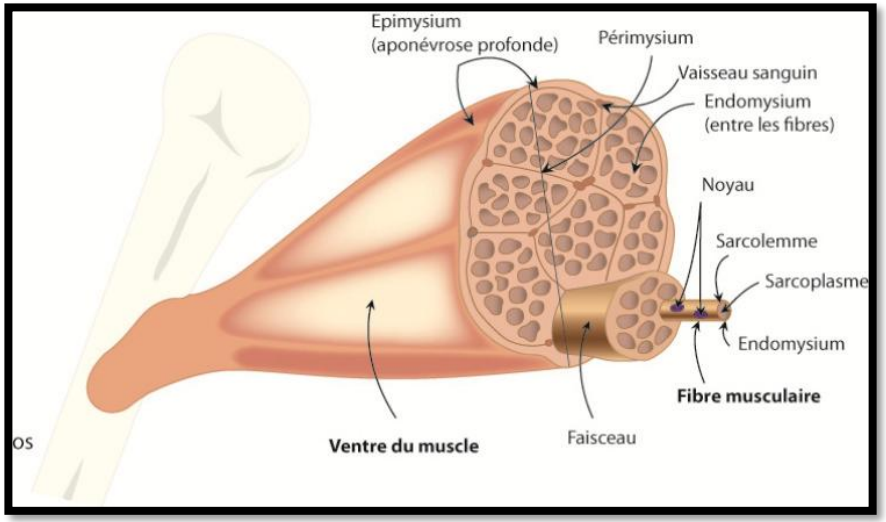
Classification des MNM

Le muscle

a) Myopathie

- Génétique
- Inflammatoire
- Métabolique
- Toxique
- Infectieuse

b) Dystrophie musculaire



http://campusport.univ-lille2.fr/physio/co/grain1_VT.html

Dystrophie musculaire de Duchenne

- E. Meyron (1852), G.B.A. Duchenne de Boulogne (1868)

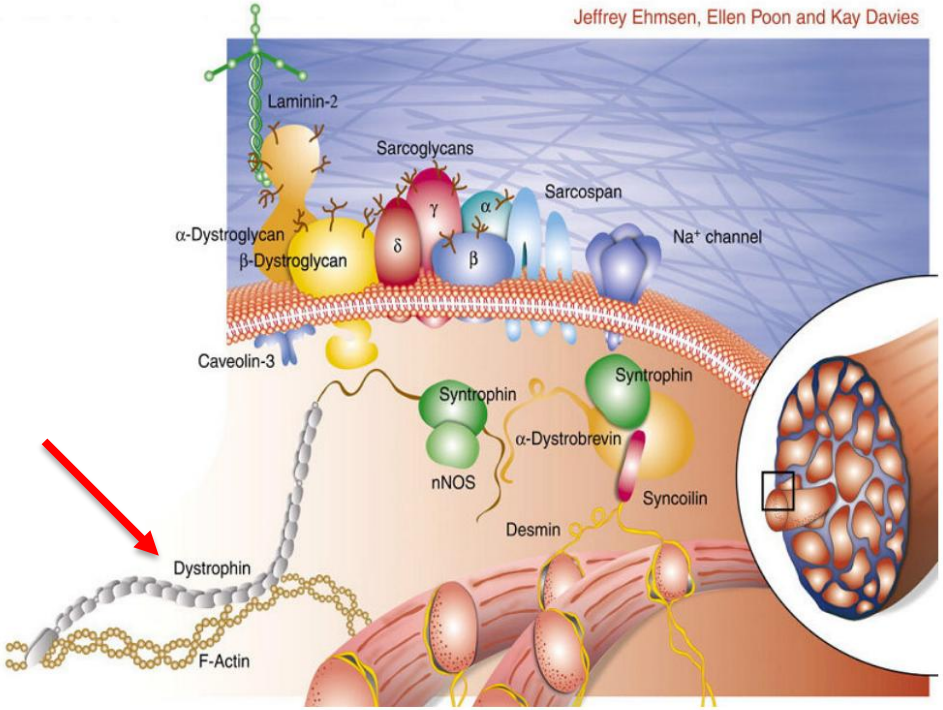


Figure 1. Overview of dystrophin in muscle

http://www.exonskipping.nl/dystrophin-protein/

Dystrophinopathie

- Dystrophie musculaire de
  - Duchenne
  - Becker
- Cardiomyopathie (dilatée) liée à l'X
- Femme avec dystrophinopathie / porteuse symptomatique

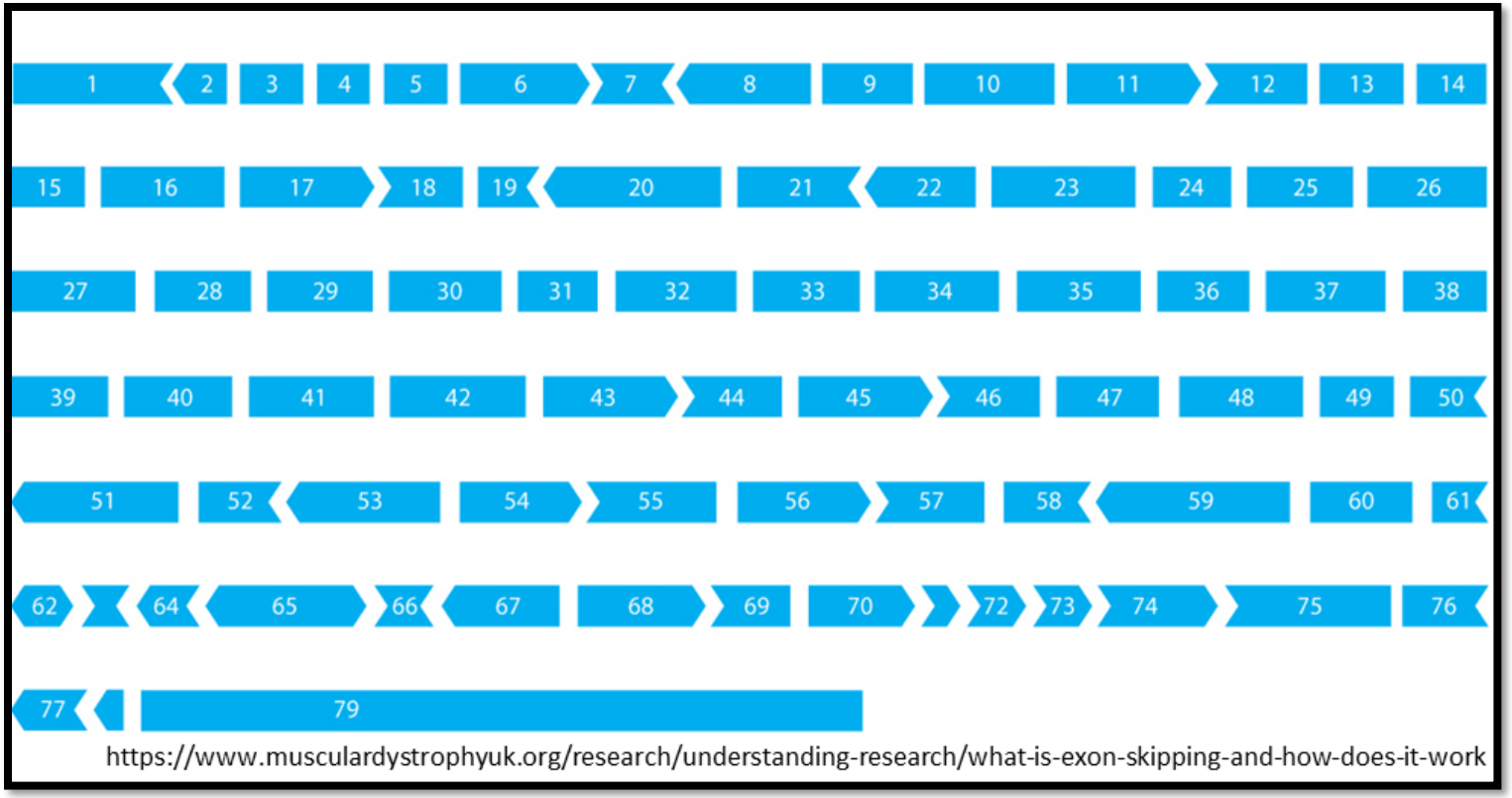
Gruber D. et al.
AJMG: Semin in Med Gen
2022, 190C:197–205

TABLE 1 Common symptoms reported in female carriers

Female carriers commonly report:
A history of weakness and clumsiness in childhood (e.g., poor performance in sports)
Proximal muscle weakness (maybe asymmetric) leading to:
Exhaustion/tired all the time (TATT)
Difficulty getting up and down stairs
Difficulty getting up from sitting to standing position
Awkward gait
Myalgia (growing pains, cramps)
Unexplained abdominal or chest pain
Tachycardia of unknown origin
Pseudohypertrophy of calf muscle

DMD: Un peu de génétique

- Incidence 1/3’600-6’000 naissances de garçons
- Maladie récessive liée à X
  - 1/3 «de novo»
    - Attention mutation lignée germinale
  - Dup / Del / mutation ponctuelle
- Gène *DMD* (Xp21.2)
  - 79 exons


1 2 3 4 5 6 7 8 9 10 11 12 13 14
15 16 17 18 19 20 21 22 23 24 25 26
27 28 29 30 31 32 33 34 35 36 37 38
39 40 41 42 43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58 59 60 61
62 64 65 66 67 68 69 70 72 73 74 75 76
77 79
https://www.musculardystrophyuk.org/research/understanding-research/what-is-exon-skipping-and-how-does-it-work

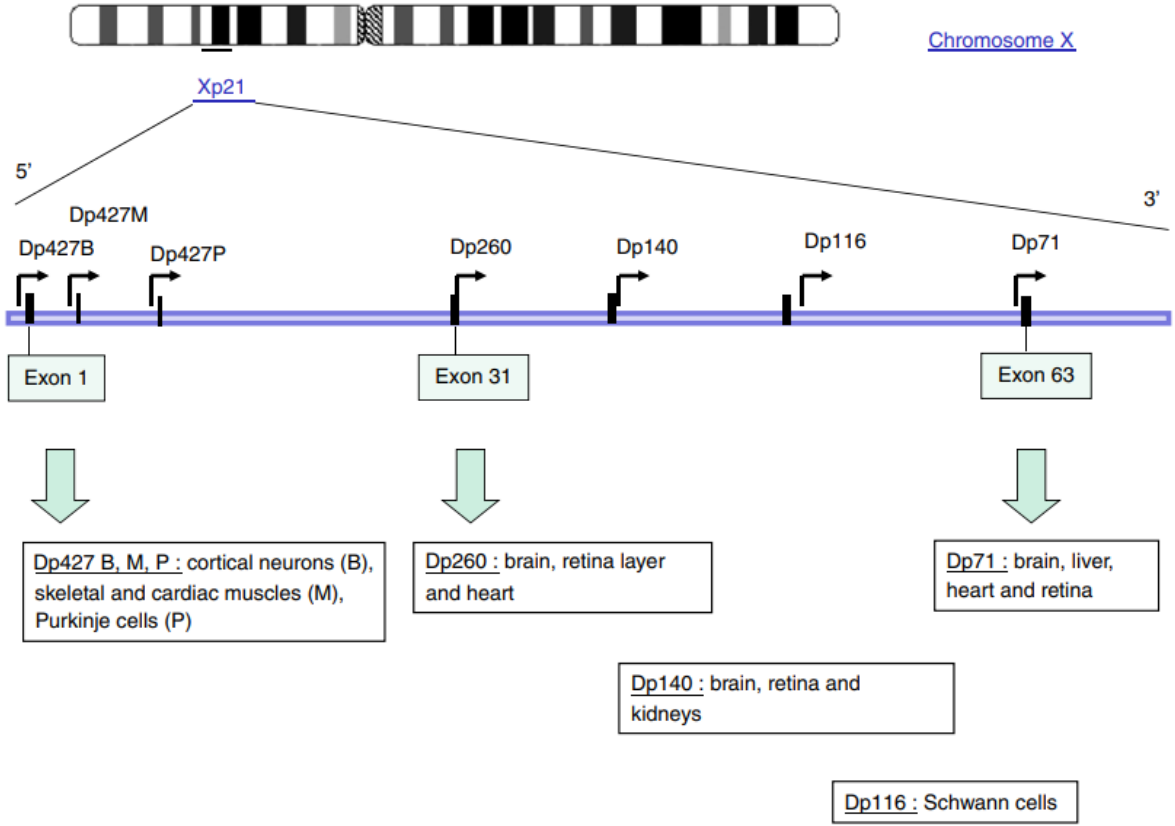


Figure 1: Genomic organization of the dystrophin gene.

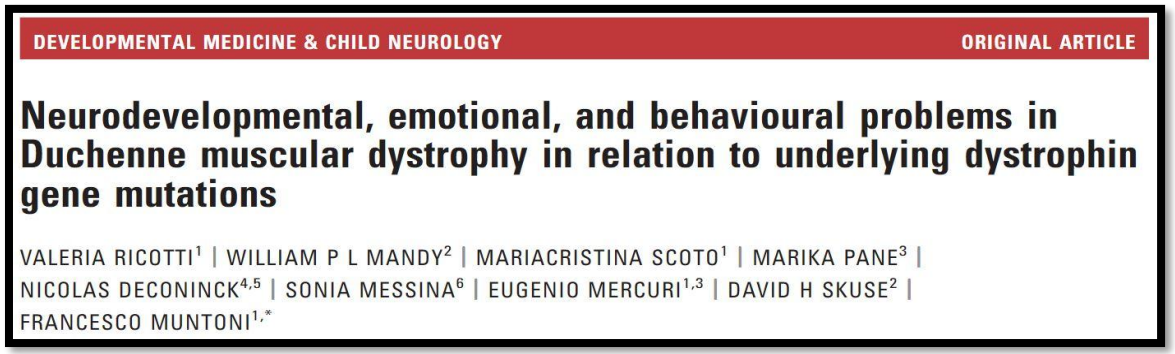
Ricotti V et al. DMCN 2016, 58: 77–84

DMD à évoquer devant…

- <u>Difficultés motrices</u>
  - Retard dév. moteur (40%)
  - Retard de la marche (20%)
  - Marche «particulière»
  - Chutes, difficultés à la course ou escaliers
  - Signe de Gowers
  - Pseudohypertrophie musculaire (mollets!)
- <u>HyperCKémie (10-200x N)</u>

Aussi si atteinte «cognitive»

- Retard langagier (25%)
- Retard global du développement
- Trouble du spectre autistique
- TDAH (30%)



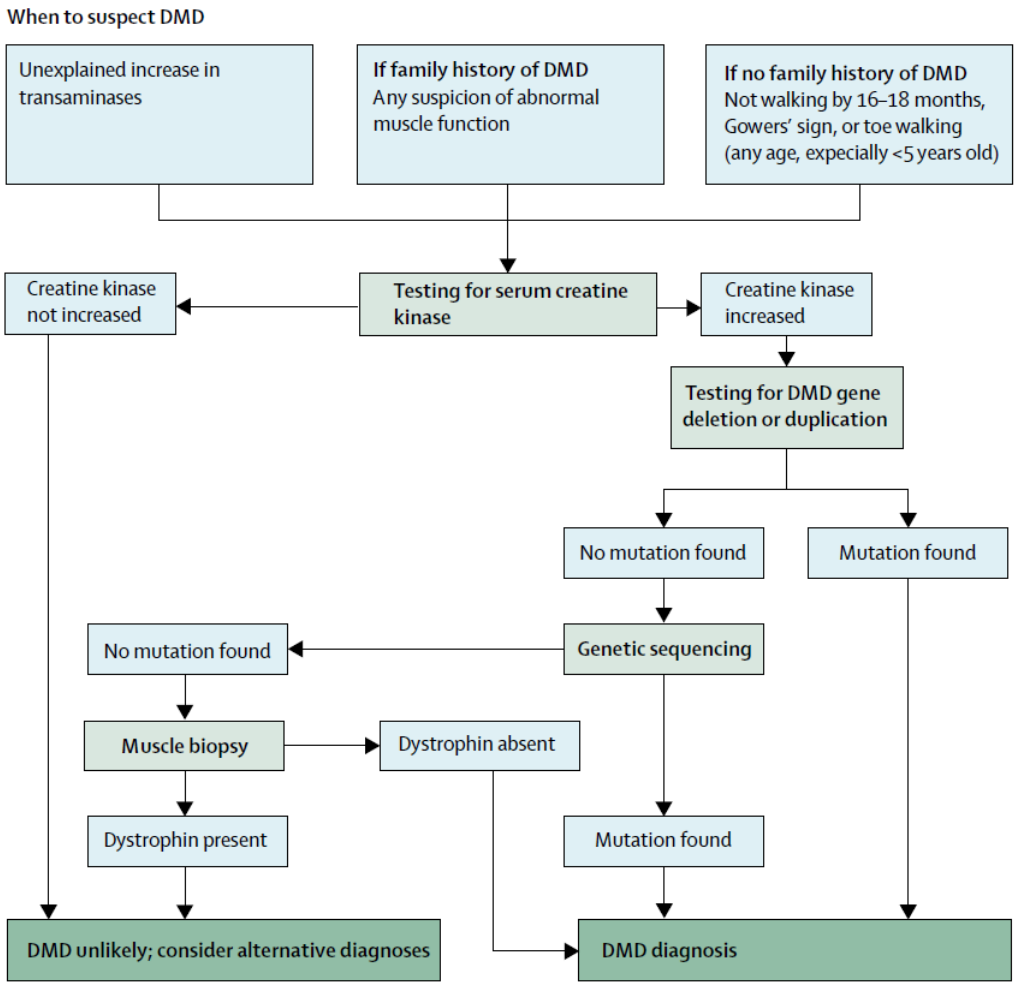
DEVELOPMENTAL MEDICINE & CHILD NEUROLOGY ORIGINAL ARTICLE

Neurodevelopmental, emotional, and behavioural problems in Duchenne muscular dystrophy in relation to underlying dystrophin gene mutations

VALERIA RICOTTI[1] | WILLIAM P L MANDY[2] | MARIACRISTINA SCOTO[1] | MARIKA PANE[3] | NICOLAS DECONINCK[4,5] | SONIA MESSINA[6] | EUGENIO MERCURI[1,3] | DAVID H SKUSE[2] | FRANCESCO MUNTONI[1,*]

Developmental Medicine & Child Neurology 2016, 58: 77–84

Démarche diagnostique



Birnkrant *et al*. *Lancet Neurol* 2018; 17: 251–67

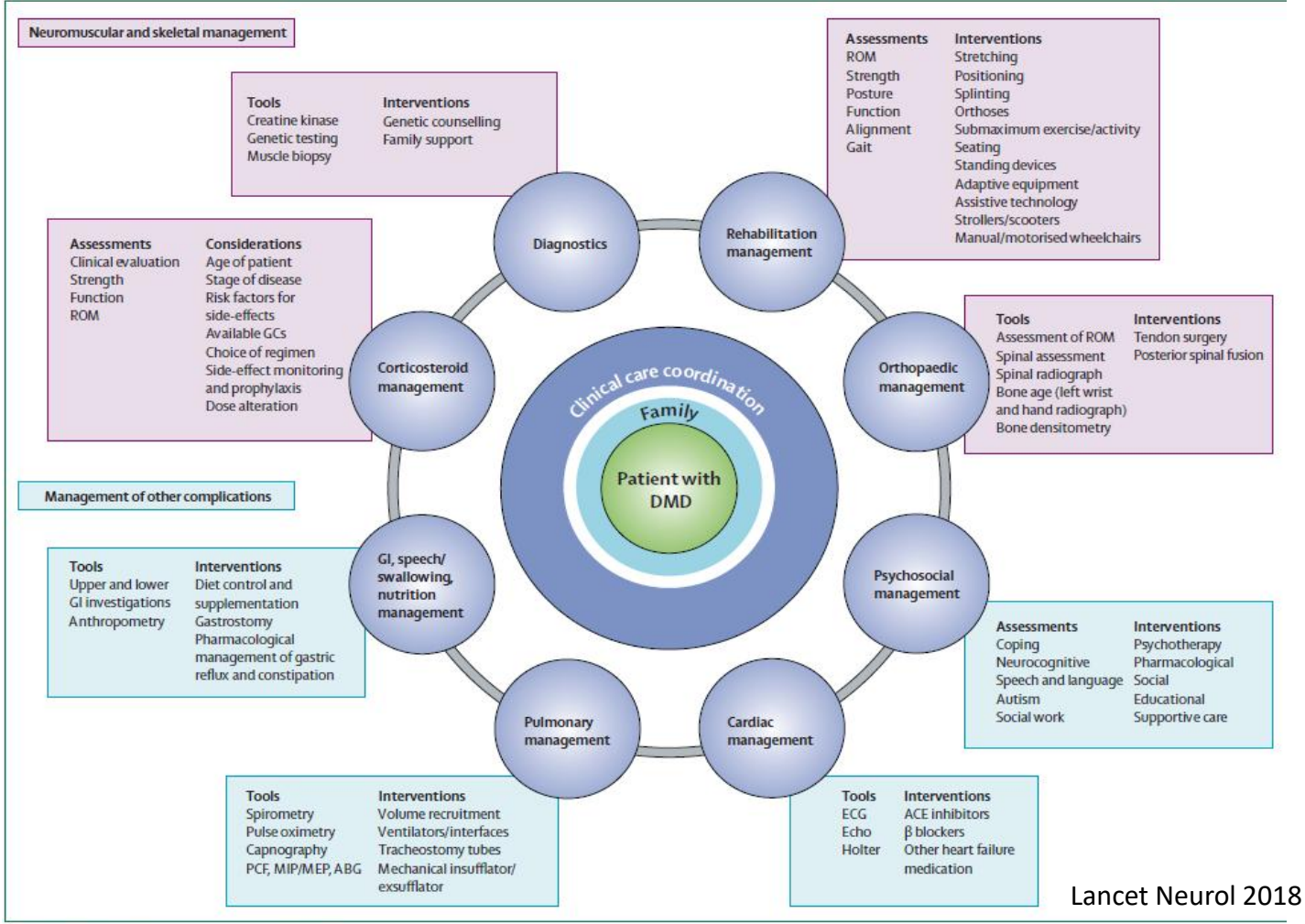
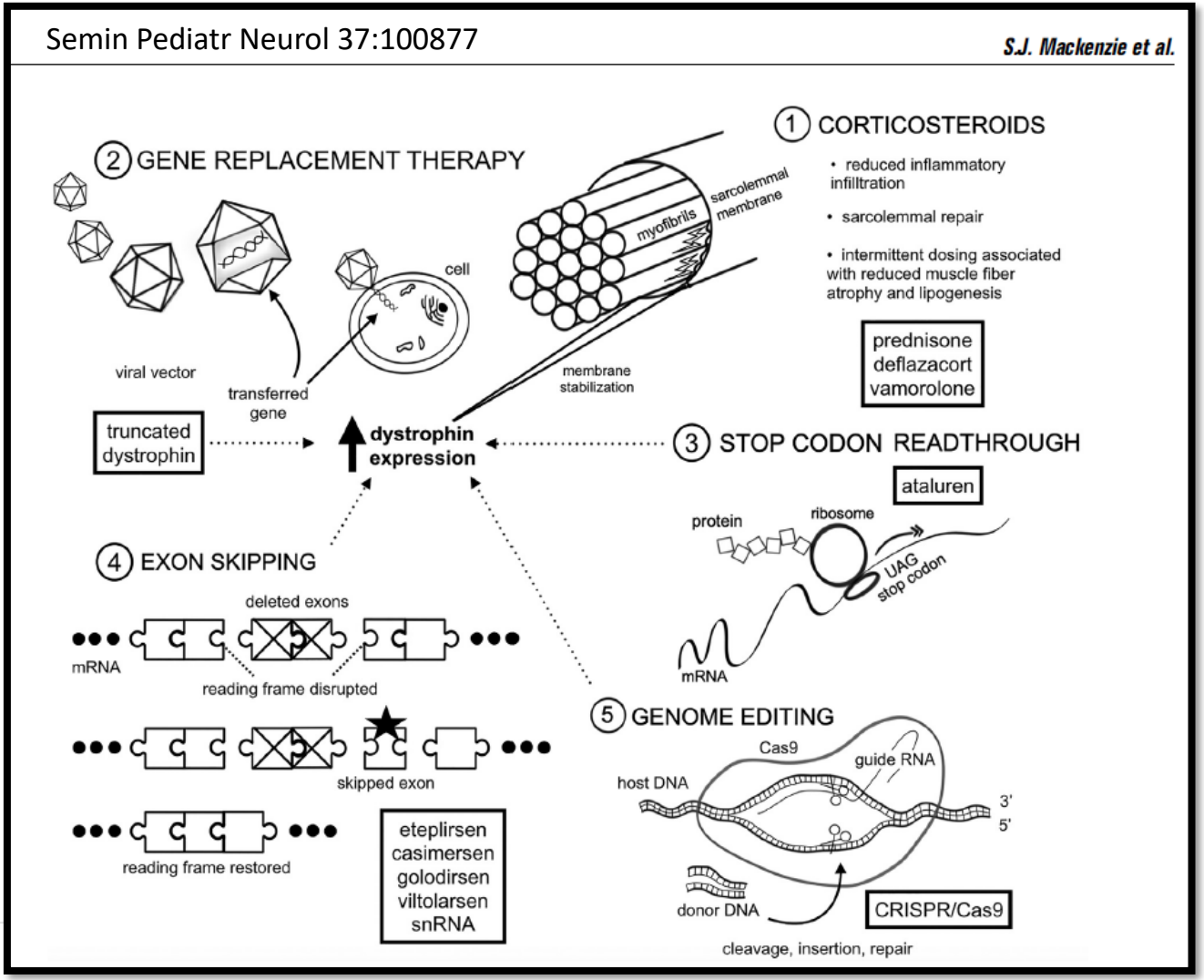


Figure 1: Interdisciplinary management of DMD

Lancet Neurol 2018

Nouvelles thérapies?



Restoring or Replacing Dystrophin | LEARN MORE »

Dystrophin restoration or replacement aims to treat the underlying cause of Duchenne which is the lack of dystrophin, the protein that provides stability to the muscles. Exon skipping and nonsense mutation readthroughs are both ways that dystrophin *restoration* is being explored. Strategies to *replace* the missing dystrophin protein include gene therapy, which uses a modified smaller version of the dystrophin gene, called micro-dystrophin, to produce a modified micro-dystrophin protein.

Combating Fibrosis | LEARN MORE »

Fibrosis, defined as the thickening and scarring of connective tissue, is a downstream symptom of the lack of dystrophin. Fibrosis occurs in Duchenne when chronic inflammation inhibits muscle repair. Reducing fibrosis may help decrease the breakdown of mature muscle cells and increase muscle strength.

Reducing Inflammation | LEARN MORE »

Inflammation is a critical characteristic of Duchenne disease progression. Due to muscle degeneration and the resulting immune cells brought in to help regenerate the muscle, a whole host of inflammatory substances are released. The muscles of individuals with Duchenne are constantly in a state of inflammation. Corticosteroids are currently the standard of care to treat inflammation but have a number of side effects associated with long-term use. There are a number of experimental therapies in development that are aimed at reducing inflammation.

Regulating Calcium Balance | LEARN MORE »

In Duchenne, because of the instability of the muscle membrane due to the lack of dystrophin, leaks in the muscle cell membrane can develop. These leaks can let too much calcium flow in and out of the muscle cell, disrupting cellular functions which further exacerbate cellular repair. Companies are developing compounds that aim to help regulate the calcium flow.

Improving Muscle Growth & Protection | LEARN MORE »

Several therapeutic options intend to encourage muscle growth and discourage muscle breakdown. There are many strategies that can be explored in this domain, including approaches to enhance repair capabilities of the muscle, protect the muscle from breakdown, reduce inflammation and fibrosis, or induce muscle development.

Parent Project Muscular Dystrophy 30

https://www.parentprojectmd.org/duchenne-drug-development-pipeline/

canton de vaud

CHUV

Corticostéroïdes et DMD

Prednisone 0.75 mg/kg/jour ou déflazacort 0.9mg/kg/j
Prise quotidienne (ou schéma alternatif)
Début entre 3-6 ans (avant déclin moteur)

Sans	Avec
• Perte de la marche début 2ème décennie • Détérioration cardio-pulmonaire • Scoliose fréquente	• Ralentissement déclin moteur (2-3 ans) • Moins de scoliose (10-20%) • Meilleure fonction cardio-pulmonaire (un peu) • *Espérance vie plus grande* • Des effets secondaires

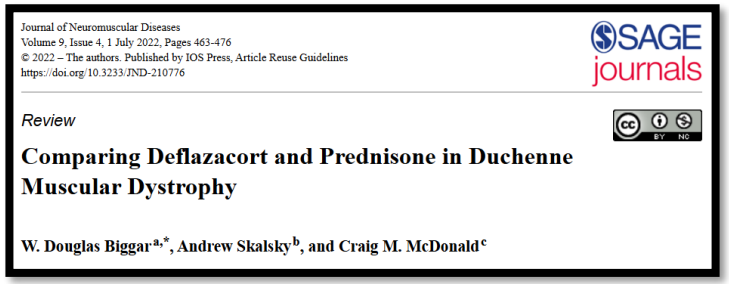
Guglieri M et al. JAMA 2022

Predniso(lo)ne

- Efficacité similaire
- Plus d'effets 2° sur poids (et comportement?)

Déflazacort

- Efficacité similaire (discrètement mieux pour la force?)
- Plus d'effets 2° sur taille, fragilité osseuse, cataracte



Journal of Neuromuscular Diseases
Volume 9, Issue 4, 1 July 2022, Pages 463-476
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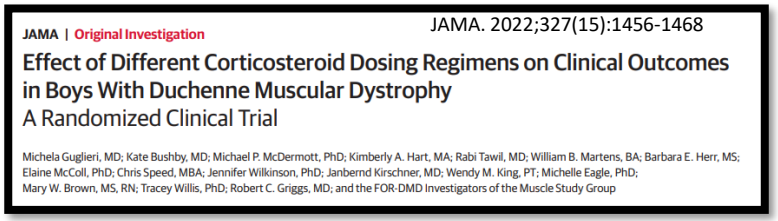
https://doi.org/10.3233/JND-210776

SAGE journals

Review

Comparing Deflazacort and Prednisone in Duchenne Muscular Dystrophy

W. Douglas Biggar[a,*], Andrew Skalsky[b], and Craig M. McDonald[c]



JAMA. 2022;327(15):1456-1468

JAMA | Original Investigation

Effect of Different Corticosteroid Dosing Regimens on Clinical Outcomes in Boys With Duchenne Muscular Dystrophy
A Randomized Clinical Trial

Michela Guglieri, MD; Kate Bushby, MD; Michael P. McDermott, PhD; Kimberly A. Hart, MA; Rabi Tawil, MD; William B. Martens, BA; Barbara E. Herr, MS; Elaine McColl, PhD; Chris Speed, MBA; Jennifer Wilkinson, PhD; Janbernd Kirschner, MD; Wendy M. King, PT; Michelle Eagle, PhD; Mary W. Brown, MS, RN; Tracey Willis, PhD; Robert C. Griggs, MD; and the FOR-DMD Investigators of the Muscle Study Group

Vamorolone

Nouvelle classe de corticoïdes dit «dissociatif»

- Effet anti-inflammatoire
- Moins d’effet gluco- et minéralocorticoïde

  = moins d’effets secondaires (en théorie)

Journal of Neuromuscular Diseases 10 (2023) 1013–1030
DOI 10.3233/JND-230161
IOS Press

Commentary

Considering the Promise of Vamorolone for Treating Duchenne Muscular Dystrophy

Miranda D. Grounds* and Erin M. Lloyd
Department of Anatomy, Physiology and Human Biology, School of Human Sciences, The University of Western Australia, Perth, Western Australia, Australia

Study Details			Pharmaco-kinetics	Results: Efficacy			Results: Safety						Ref.
Study ID	Treatment duration	Comparisons		Pathology severity	Inflam.	Muscle function	Clinical safety	Growth	Adrenal suppression	Bone turnover	Insulin resistance	Other	
VBP15-001 (normal males, aged 19-64 yrs) **VBP15-002**	1 dose or 2 wks		⊖ VAM ≈ GCs										[42]
VBP15-002	2 wks	vs BL	⊖ VAM = GCs	✓ ↓ CK (2wks post treatment end)	✓ PD biomarkers: ↓ CD23, IL-22BP, MMP-12, CCL22, IGFBP-2 ⊖: no change in ITGα1/β1, LTα1/β2		⊖ No change in vital signs, ECG, haematology, biochemistry, lipid profile, urinalysis, liver function	⊖ No change in BMI	✗ 38% subjects reduced morning cortisol	⊖ ✓: ↓ CTX ✗: ↓ osteocalcin, ↓ P1NP	⊖ No change fasting glucose, insulin. ✗: PD biomarker: ↑ AFM.	✗ PD biomarker: ↑ AGT	[43]
VBP15-002/003	2 wks, 26 wks (~6 mos)	vs BL			✓ PD biomarkers: ↓ CD23, CCL22, LTα1/β2, IGFBP-2, MMP-12 (2 wks)	✓ ↑ TTSTAND velocity, 6MWT distance, ↓ TTCLIMB, TTRW time (24 wks)							[40]
VBP15-002/003	26 wks (~6 mos)	vs BL, steroid naïve DNHS, or low-dose VAM (0.25 mg/kg/d)				✓ ↑ ΔTTSTAND & ΔTTRW velocities. ⊖: no difference in NSAA (vs DNHS)	⊖ No change in vital signs, ECG, haematology, biochemistry, lipid profile, urinalysis, liver function	✗ ↑ BMI z-score (vs BL), ↑ ΔBMI z-score (vs low dose)	✗ ↓ ACTH. 62% subjects reduced morning cortisol (vs BL)	✓ ↓ CTX ⊖: no change in osteocalcin, P1NP (vs BL)	⊖ ✓: ↓ fasting glucose ✗: ↑ fasting insulin ⊖: no change in HbA1c (vs BL)		[21]
VBP15-002/003/LTE	78 wks (~18 mos)	vs BL, steroid naïve DNHS				✓ ↑ TTSTAND, TTCLIMB & TTRW velocities, 6MWT distance, NSAA score		⊖ ✓: ↑ height percentile ✗: ↑ BMI z-score.					[41]
VBP15-002/003/LTE	130 wks (~30 mos)	vs steroid naïve, PRED- and DEF-treated DNHS				⊖ No difference in disease progression (TTSTAND, TTRW & TTCLIMB velocities) vs other treatments							[44]
VBP15-002/003/LTE	130 wks (~30 mos)	vs BL				⊖ No change in TTSTAND, TTCLIMB, & TTRW velocities, 6MWT distance, PODCI & QMT scores	⊖ No change in vital signs, ECG, haematology, biochemistry, lipid profile, urinalysis, liver function.	⊖ No change in height percentile, BMI z-score.					[39]
VBP15-004	24 wks	vs PBO				✓ ↑ ΔTTSTAND, ΔTTCLIMB, &ΔTTRW velocities, Δ6MWT distance, ΔNSAA score. ⊖: no difference in PODCI, handheld myometry.		⊖ No difference in height percentile, BMI z-score.	✗ ↓ morning cortisol. 90% subjects with reduced ACTH-stimulated cortisol	⊖ No difference in CTX, osteocalcin, P1NP		✗ Behaviour:↓ PARS III. ⊖: no difference in TSQM	[38]

Abbreviations: 6MWT = 6-minute walk test, AFM = afamin, AGT = angiotensinogen, CCL22 = C-C motif chemokine 22 (macrophage-derived chemokine), CD23 = Fc epsilon receptor II, CK = creatine kinase, DNHS = DMD Natural History Study (NCT00468832), DEF = deflazacort, GC = glucocorticoid, HbA1c = haemoglobin A1c, IGFBP-2 = insulin-like growth factor binding protein-2, IL-22BP = interleukin-22 binding protein, ITGα1/β1 = integrin α1β1, LTα1/β2 = lymphotoxin α1/β2, MMP-12 = matrix metalloproteinase 12, NSAA = North Star Ambulatory Assessment, PARS III = Personal Adjustment and Role Skills Scale ed. 3, PBO = placebo (i.e., vehicle control), PD = pharmodynamic, PK = pharmacokinetics, PODCI = Pediatric Outcomes Data Collection Instrument, PRED = prednisone, QMT = Quantitative Muscle Testing, TSQM = Treatment Satisfaction Questionnaire for Medication, TTCLIMB = time to climb test, TTRW = time to run/walk 10 meters test, TTSTAND = time to stand test, Δ = change from baseline to end treatment duration.
*Lower doses of vamorolone (i.e., 0.25 and 0.75 mg/kg/d) were found to be insufficient to meaningfully affect the outcome measures [40]

Un peu d'argent…

Prednisone

- Suisse: ≈ 0.02 CHF par mg

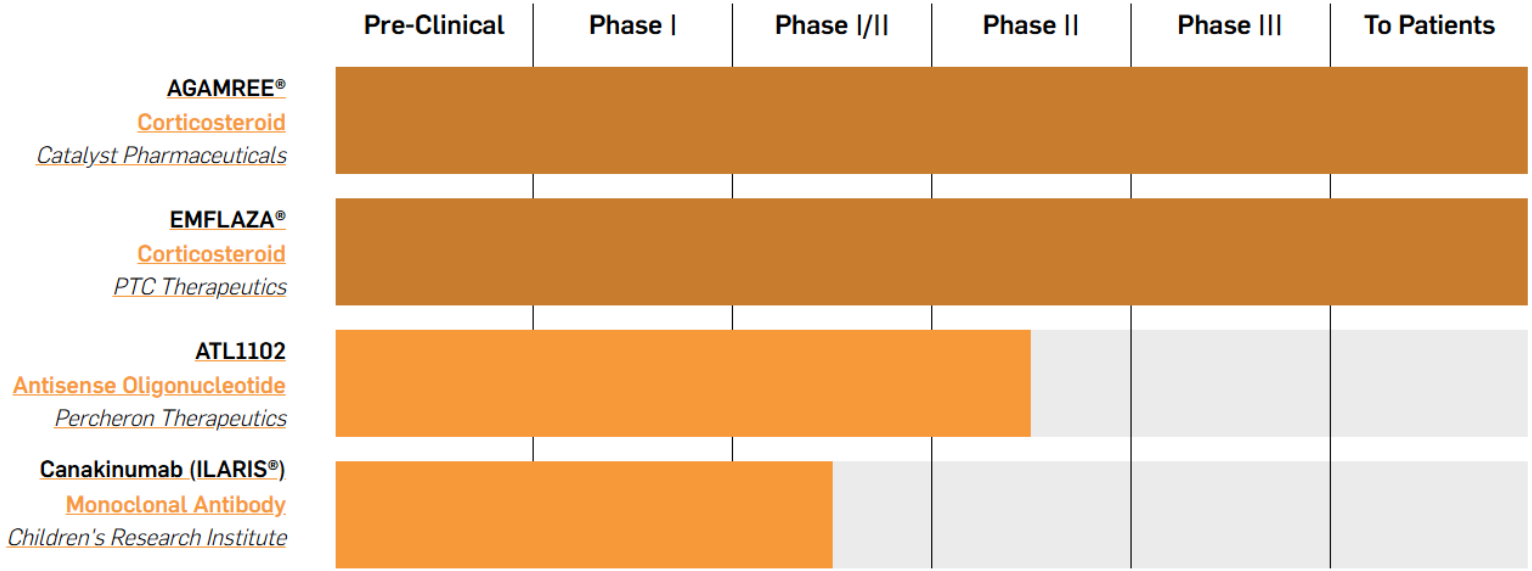
Déflazacort

- Italie: ≈ 0.04 CHF par mg
- USA: ≈ 20 CHF par mg

Vamorolone

- Allemagne ≈ 0.85 CHF/mg

Valeurs approximatives


Pre-Clinical
Phase I
Phase I/II
Phase II
Phase III
To Patients
AGAMREE®
Corticosteroid
Catalyst Pharmaceuticals
EMFLAZA®
Corticosteroid
PTC Therapeutics
ATL1102
Antisense Oligonucleotide
Percheron Therapeutics
Canakinumab (ILARIS®)
Monoclonal Antibody
Children's Research Institute

Givinostat (Duvyzat®)

- FDA pour ≥6 ans
- Per os

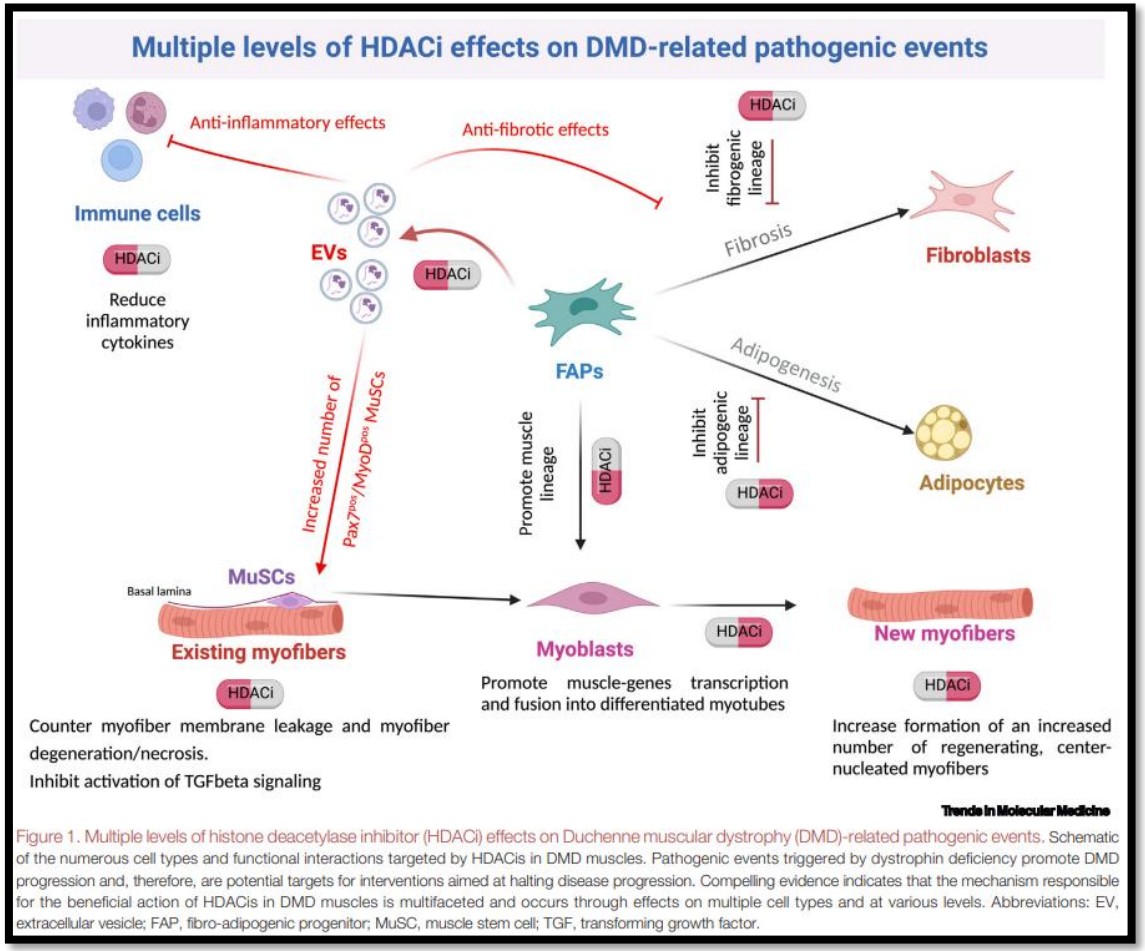
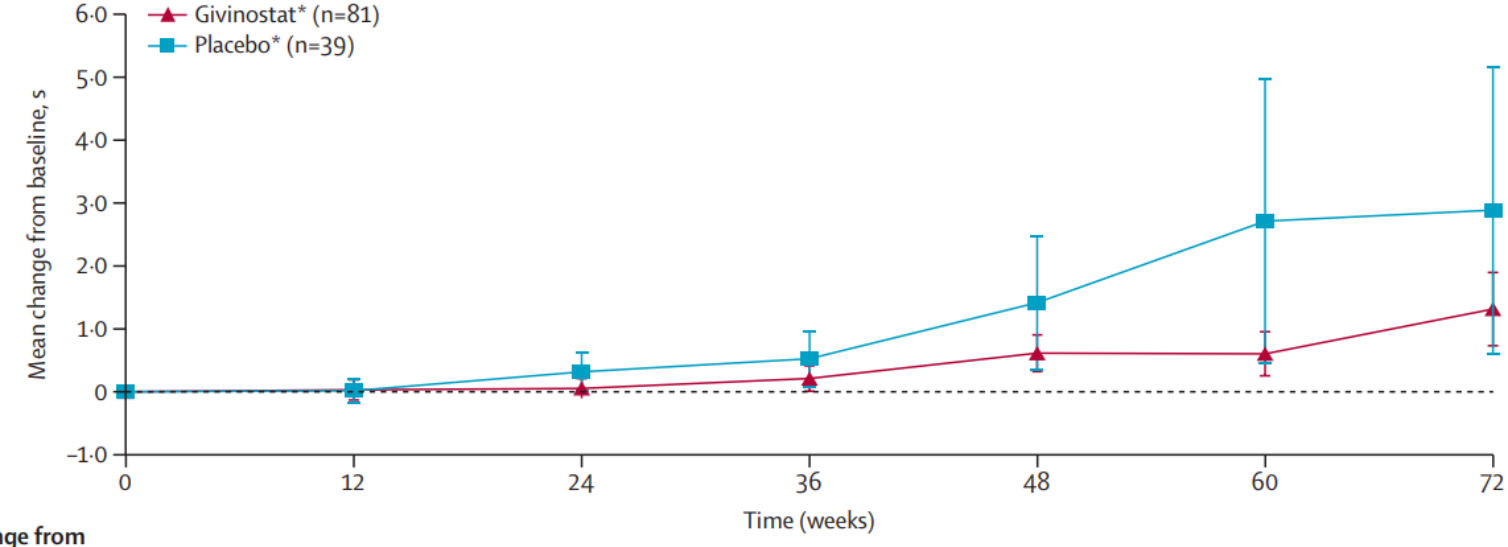


Figure 1. Multiple levels of histone deacetylase inhibitor (HDACi) effects on Duchenne muscular dystrophy (DMD)-related pathogenic events. Schematic of the numerous cell types and functional interactions targeted by HDACis in DMD muscles. Pathogenic events triggered by dystrophin deficiency promote DMD progression and, therefore, are potential targets for interventions aimed at halting disease progression. Compelling evidence indicates that the mechanism responsible for the beneficial action of HDACis in DMD muscles is multifaceted and occurs through effects on multiple cell types and at various levels. Abbreviations: EV, extracellular vesicle; FAP, fibro-adipogenic progenitor; MuSC, muscle stem cell; TGF, transforming growth factor.

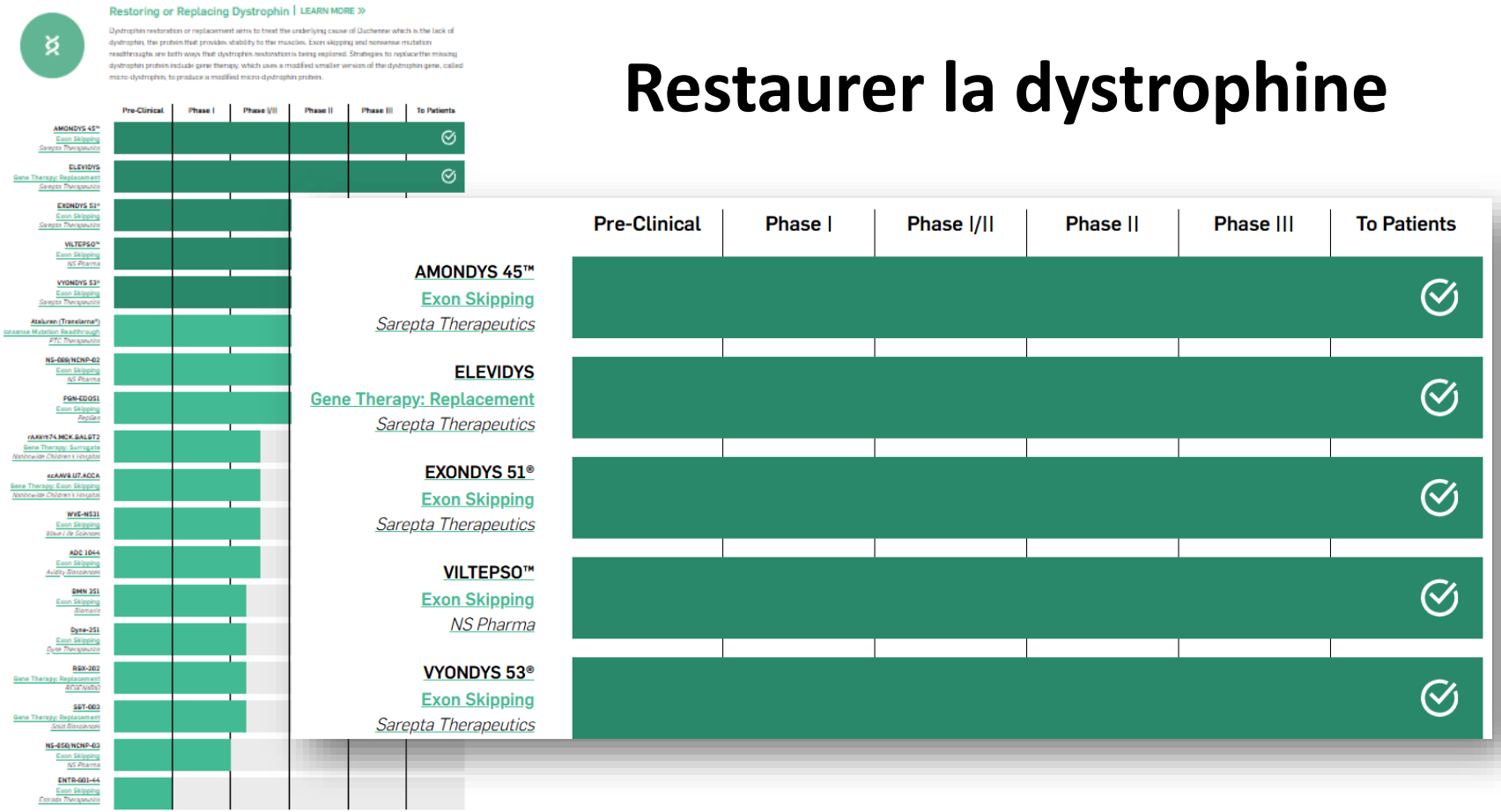


Mean change from baseline (95% CI), s						
Givinostat	0·03 (−0·13 to 0·19)	0·05 (−0·10 to 0·21)	0·21 (0·01 to 0·41)	0·61 (0·32 to 0·91)	0·60 (0·26 to 0·95)	1·31 (0·73 to 1·90)
Placebo	0·18 (−0·19 to 0·23)	0·32 (−0·00 to 0·64)	0·53 (0·07 to 0·98)	1·42 (0·34 to 2·49)	2·71 (0·45 to 4·98)	2·89 (0·60 to 5·18)

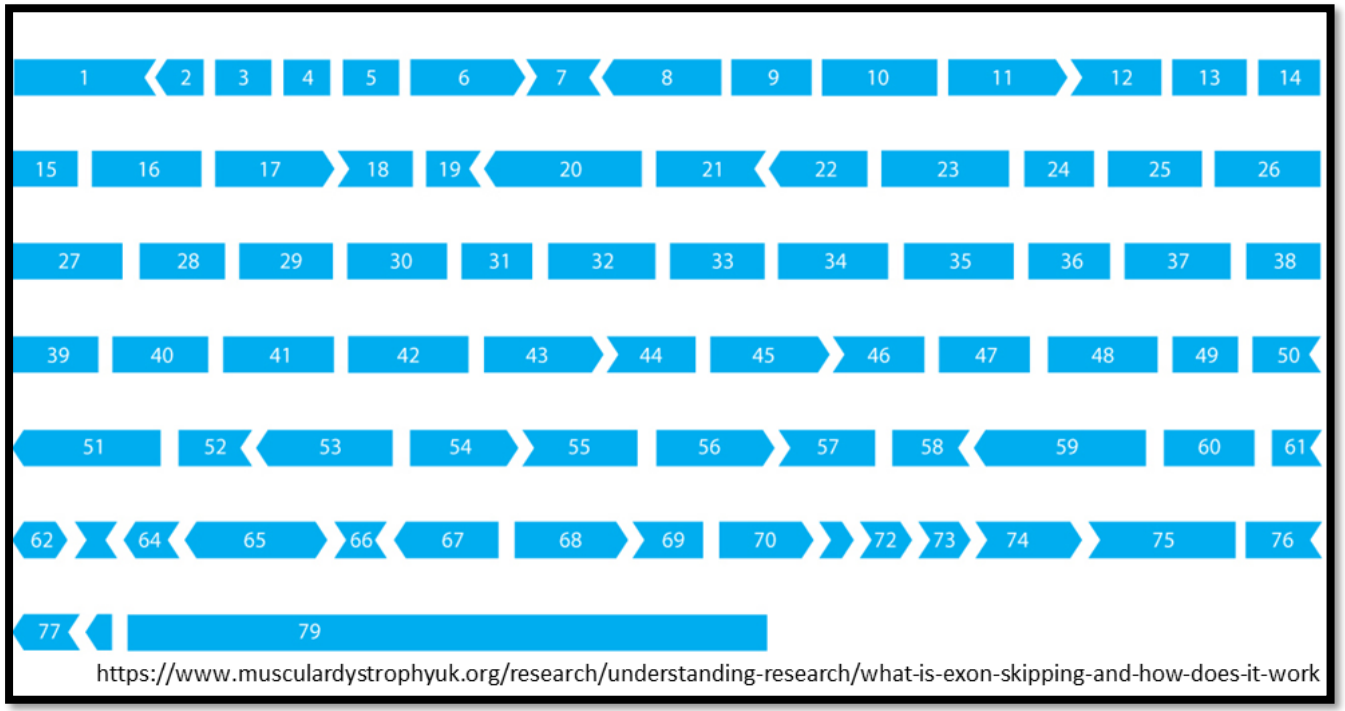
Figure 3: **Mean change in results of the four-stair climb assessment between baseline and 72 weeks**
Assessed in the group A part of the intention-to-treat population. Data are mean (95% CI). The CIs have not been adjusted for multiplicity and should not be used for hypothesis testing. Baseline mean values were 3·39 s for the givinostat group and 3·48 s for the placebo group. *All patients were also receiving systemic corticosteroids, in a dose and regimen that was to remain unchanged over the follow-up period.

Mercuri E et al. Lancet Neurol 2024; 23: 393–403

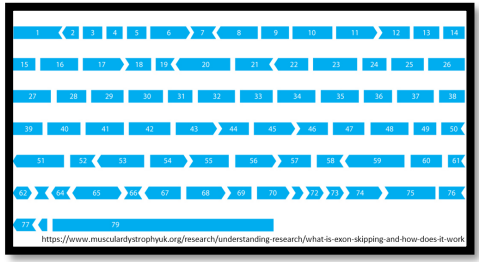
Restaurer la dystrophine



Le saut d'exon



Le saut d'exon



- Pour les exons 44, 45, 51, 53
- Perfusion IV 1x/semaine
- Aux USA:
  - Casimersen (Amondys 45®)
  - Eteplirsen (Exondys 51 ®)
  - Vitolarsen (Viltepso ®)
  - Golodirsen (Vyondys 53 ®)

Pas autorisés en CH ou en Europe

La thérapie génique…

Table 1. Comparison of recent micro-dystrophin trials with their key data points and outcomes as of November 2024. Dosages administered, patient age, current status/outcomes of the trials, and adverse events are summarized.

Clinical Trial ID	Treatment	Vector	Patient age	Dosage	Outcome	Adverse effects	Start/End Dates
NCT05096221	delandistrogene moxeparvovec	AAVrh74	4–8 years	1.33×10^{14} vg/kg	favorable safety, not statistically significant efficacy in phase III	no serious adverse events, 674 mild adverse events in treated patients	2021/10/27–2023
NCT05693142	RGX-202	AAV8	4–11 years	1×10^{14} or 2×10^{14} gc/kg	favorable safety, phase III trial expected in 2024	no serious adverse events	1/4/2023–2025
2020–002093–27	GNT0004	AAV8	6–10 years	1×10^{13} or 3×10^{13} vg/kg	tolerable safety, efficacy to be determined	5 adverse drug reactions, 4 mild events	6/24/2020–2028
NCT06138639	SGT-003	AAV-SLB101	4–6 years, 7–11 years	to be determined	safety and efficacy to be determined	to be determined	2024/05/06–2031
NCT04281485	fordadistrogene movaparvovec	AAV9	4–7 years	unspecified	on hold	2 fatal adverse events in related trials	2020/11/05–2029
NCT03362502	fordadistrogene movaparvovec	AAV9	6.2–13 years	but 1×10^{14} or 3×10^{14}	on hold	1 fatal adverse event, and 1 in related trial	2018-01-23-2026

Tang A & Yokota T. Expert Opin Drug Saf. 2025 Apr;24(4):395-411

A l’heure actuelle

Delandistrogene moxeparvovec (Elevidys®)

approuvé seulement aux USA:

- Patient ≥ 4 ans
- Pas d’anticorps anti-AAVrh74 (vecteur)
- Pas de délétion touchant exon 8 et/ou 9

Nécessité de prednisone 1-1.5mg/kg/jour + dose habituelle, pendant 2 mois au mois

Sinon?

Diagnosis and management of Duchenne muscular dystrophy, part 1: diagnosis, and neuromuscular, rehabilitation, endocrine, and gastrointestinal and nutritional management

Diagnosis and management of Duchenne muscular dystrophy, part 2: respiratory, cardiac, bone health, and orthopaedic management

Diagnosis and management of Duchenne muscular dystrophy, part 3: primary care, emergency management, psychosocial care, and transitions of care across the lifespan

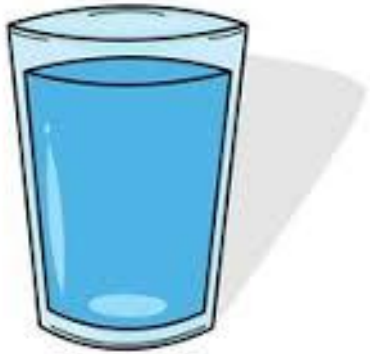
*David J Birnkrant, Katharine Bushby, Carla M Bann, Susan D Apkon, Angela Blackwell, Mary K Colvin, Linda Cripe, Adrienne R Herron, Annie Kennedy, Kathi Kinnett, James Naprawa, Garey Noritz, James Poysky, Natalie Street, Christina J Trout, David R Weber, Leanne M Ward, for the DMD Care Considerations Working Group**

Lancet Neurol 2018

Research Report

Adult North Star Network (ANSN): Consensus Guideline For The Standard Of Care Of Adults With Duchenne Muscular Dystrophy

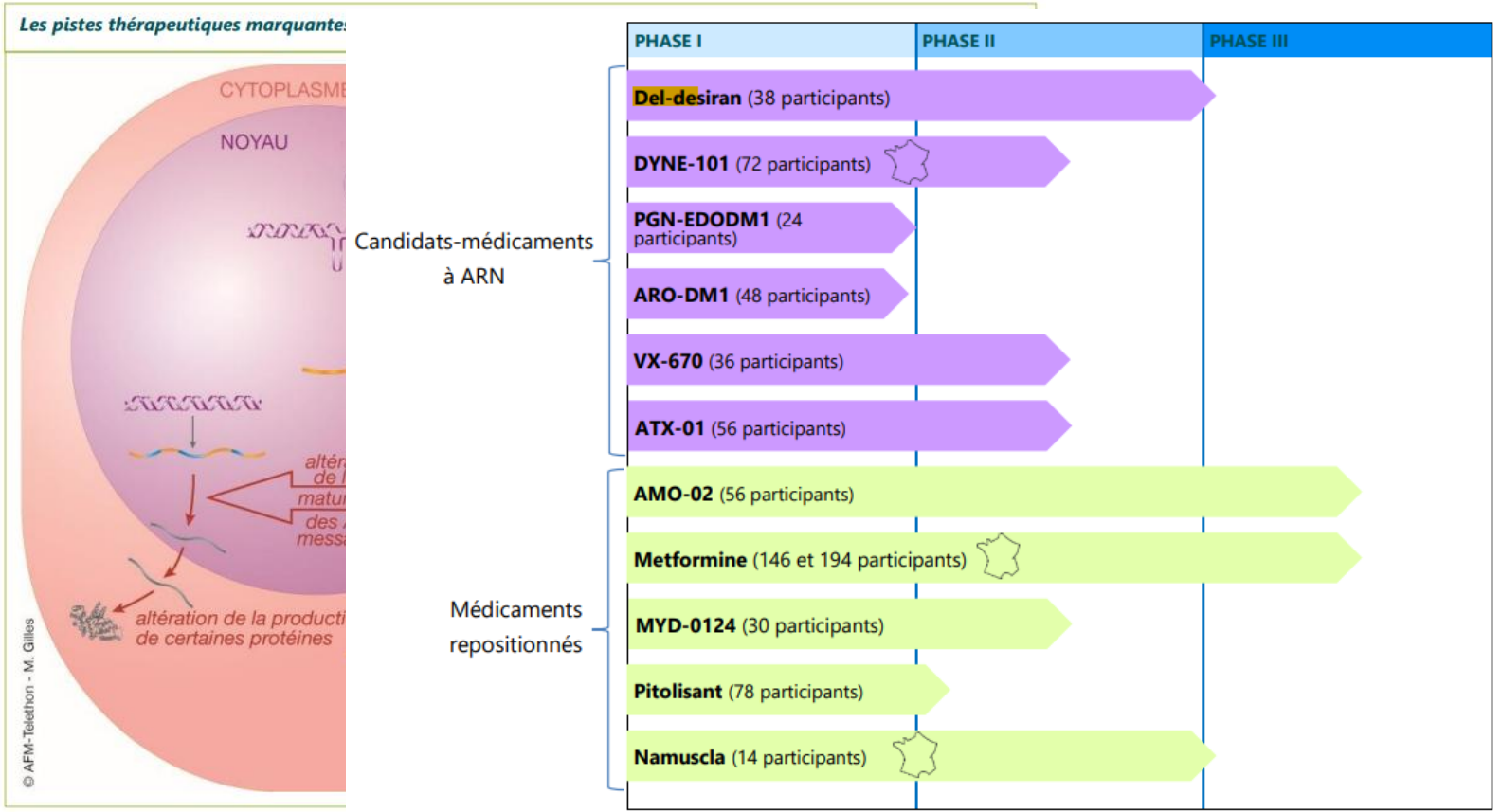
Quinlivan R et al.
Journal of Neuromuscular Diseases 8 (2021) 899–926



AUTRES DYSTROPHIES MUSCULAIRES

Dystrophie myotonique type 1

Dystrophie myotonique type 1



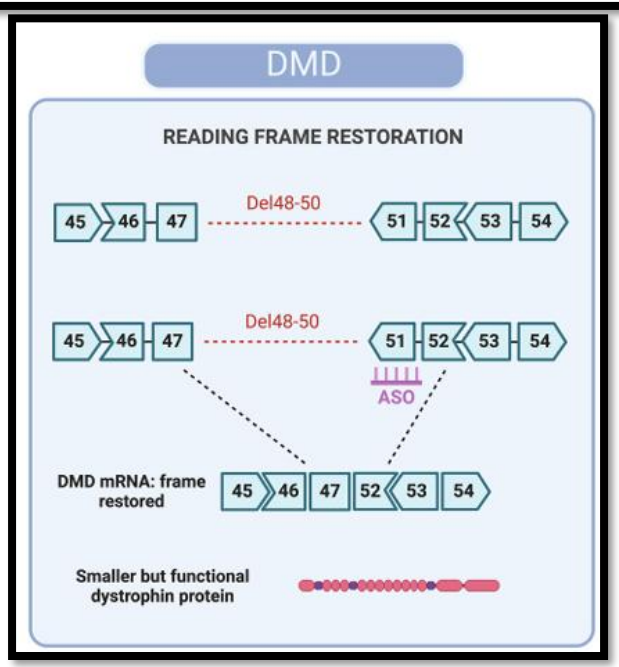
Review article

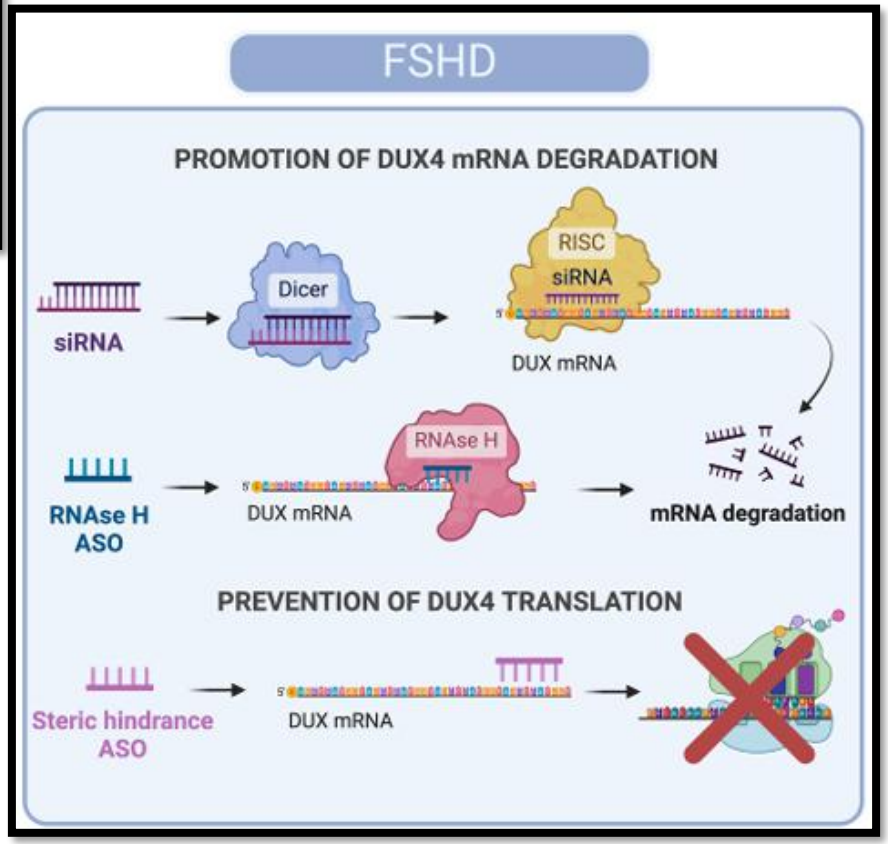
Antisense RNA therapies for muscular dystrophies

Virginia Arechavala-Gomeza[1,2], Andrea López-Martínez[1] and Annemieke Aartsma-Rus[3]

Journal of Neuromuscular Diseases
1–11

DOI: 10.1177/22143602251324858
journals.sagepub.com/home/jnd
Sage | IOS Press





Ajout du 06.4 car question posée

RESEARCH ARTICLE OPEN ACCESS

Phase 1 Open-Label Study of Omigapil in Patients With LAMA2- or COL6-Related Dystrophy

A. Reghan Foley, MD, Pomi Yun, MD, MPH, Meganne E. Leach, MSN, Sarah B. Neuhaus, DO, Gilberto V. Averion, BSN, Ying Hu, MS, Leslie H. Hayes, MD, Sandra Donkervoort, MS, CGC, Minal S. Jain, DSc, PT, Melissa Waite, MSPT, Rebecca Parks, MS, Diana X. Bharucha-Goebel, MD, Oscar H. Mayer, MD, Yaqun Zou, MD, Margaret Fink, MD, Jameice DeCoster, PsyD, MPH, Christopher Mendoza, Cynthia Arévalo, BA, Rudolf Hausmann, PhD, Diana Petraki, MSc, Ken Cheung, PhD, and Carsten G. Bönnemann, MD

Correspondence
Dr. Foley
reghan.foley@nih.gov
or Dr. Bönnemann
carsten.bonnemann@nih.gov

Neurol Genet 2024;10:e200148. doi:10.1212/NXG.0000000000200148

MYOPATHIES CONGÉNITALES

Avancées dans les **myopathies congénitales**

SAVOIR & COMPRENDRE

4 faits marquants de ces 12 derniers mois

Avancées 2024 dans les myopathies congénitales

Juin 24

RYR1

Némaline

Sélénopathie

XLMTM (MTM1)

Plusieurs stratégies thérapeutiques à l'étude chez l'animal

- De nouvelles pistes thérapeutiques continuent d'être explorées comme **l'édition génomique de base** dans la myopathie liée à *RYR1*, des petites molécules **activatrices de la troponine** dans la myopathie à némaline liée à *ACTA1*, des **activateurs de la myosine** dans la myopathie à némaline liée à *NEB* ou des **inhibiteurs de la myosine** dans les myopathies liées à *TPM2*, *TPM3* ou *TNNT1*.
- **L'acide tauro-urso-désoxycholique** (TUDCA) dans la myopathie liée à *SELENON* et les **inhibiteurs du *SOCE*** dans les myopathies liées à *STIM1* ou *ORAI1* donnent également des résultats précliniques encourageants.
- Une nouvelle piste à l'étude dans la myopathie myotubulaire consiste à **inhiber l'enzyme *PI3K-C2β*** dont l'action est inverse de celle de la myotubularine.

Des essais chez l'homme

- Un médicament en développement aux États-Unis, de la **famille des rycal**, a donné des premiers résultats encourageants chez l'homme dans les myopathies liées à *RYR1* avec fuite calcique.
- Des résultats de l'essai de **thérapie génique** dans la myopathie myotubulaire contrastés : sur les 24 enfants traités, quatre sont décédés mais 16 sont capables de respirer sans assistance, 20 sont en capacité de tenir assis, 12 peuvent se lever seuls et 8 marcher sans aide.

canton de vaud

CHUV

Nouvelles tous les jours?

Safety and efficacy of gene replacement therapy for X-linked myotubular myopathy (ASPIRO): a multinational, open-label, dose-escalation trial

Lancet Neurol 2023;22: 1125–39

Perry B Shieh, Nancy L Kuntz, James J Dowling, Wolfgang Müller-Felber, Carsten G Bönnemann, Andreea M Seferian, Laurent Servais, Barbara K Smith, Francesco Muntoni, Astrid Blaschek, A Reghan Foley, Dimah N Saade, Sarah Neuhaus, Lindsay N Alfano, Alan H Beggs, Ana Buj-Bello, Martin K Childers, Tina Duong, Robert J Graham, Minal Jain, Julie Coats, Vicky MacBean, Emma S James, Jun Lee, Fulvio Mavilio, Weston Miller, Fatbardha Varfaj, Michael Murtagh, Cong Han, Mojtaba Noursalehi, Michael W Lawlor, Suyash Prasad, Salvador Rico

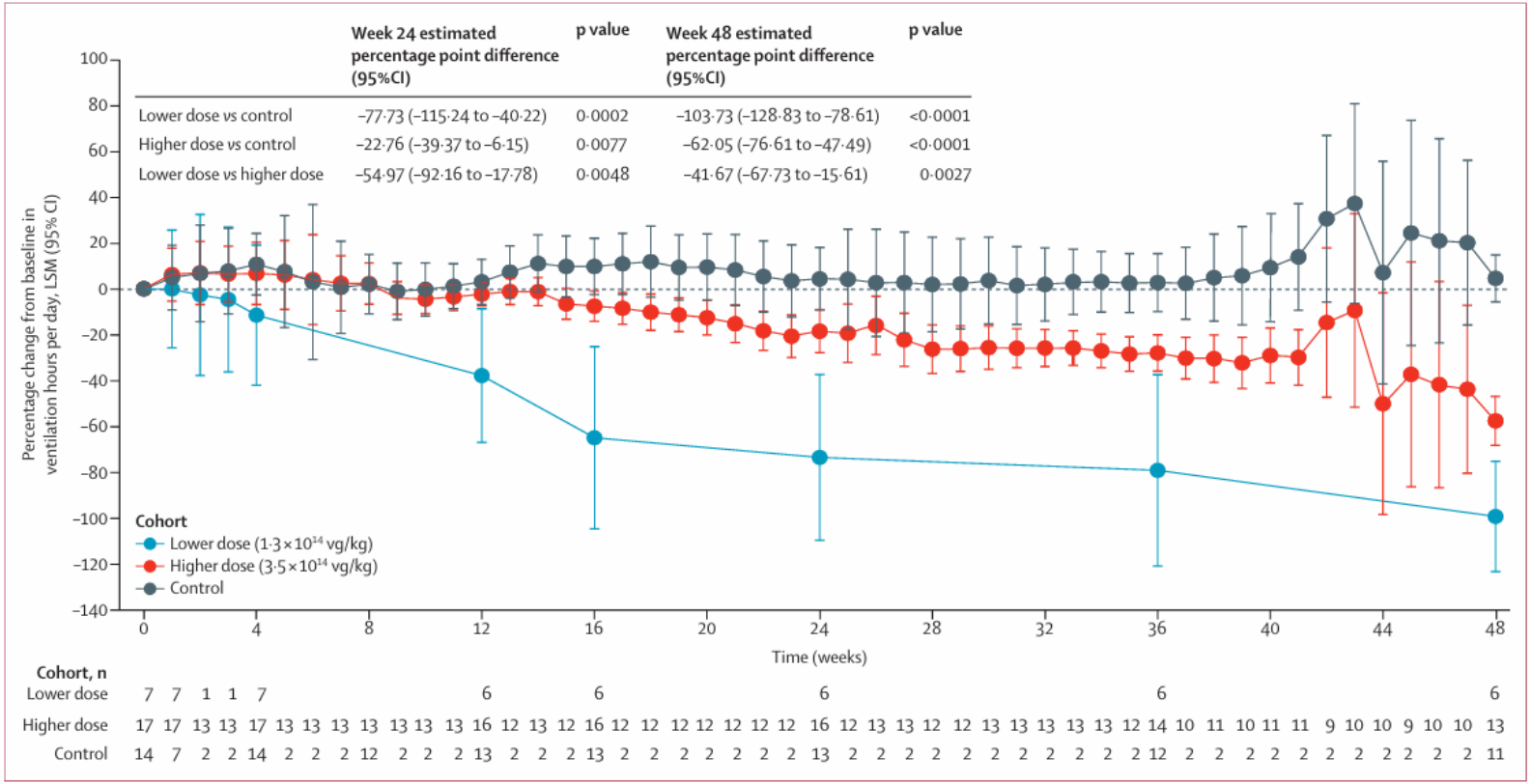


Figure 2: **Respiratory outcomes in dosed and control participants**

LSM percentage change from baseline in ventilation hours per day. Error bars indicate 95% CIs from a repeated measures analysis of covariance model. LSM=least squares mean. vg/kg=vector genomes per kg bodyweight.

Shieh PB *et al*. Lancet Neurol 2023;22: 1125–39

	Lower dose cohort, $1{\cdot}3\times10^{14}$ vg/kg (n=7)	Higher dose cohort, $3{\cdot}5\times10^{14}$ vg/kg (n=17)	Control cohort (n=14)
Any TEAE	7 (100%)	17 (100%)	14 (100%)
Treatment-related TEAE	6 (86%)	17 (100%)	0
Severe TEAE (grade ≥3)	7 (100%)	12 (71%)	13 (93%)
Serious TEAE	5 (71%)	13 (76%)	13 (93%)
Treatment-related serious TEAE	2 (29%)	9 (53%)	0
TEAE leading to study discontinuation	1 (14%)	1 (6%)	2 (14%)
TEAE resulting in death	1 (14%)	3 (18%)	3 (21%)

TEAE=treatment-emergent adverse event.

***Table 3*: Summary of TEAEs in dosed and control participants**

Gene therapy for X-linked myotubular myopathy: the challenges

Nicol C Voermans, Ana Ferreiro, Annemieke Aartsema-Rus, Heinz Jungbluth

EXPERT OPINION ON BIOLOGICAL THERAPY
https://doi.org/10.1080/14712598.2025.2473430

Taylor & Francis
Taylor & Francis Group

REVIEW

OPEN ACCESS Check for updates

X-linked myotubular myopathy: an untreated treatable disease

Cristina Martin[a] and Laurent Servais[a,b]

[a]Department of Paediatrics, MDUK Oxford Neuromuscular Centre & NIHR Oxford Biomedical Research Centre, University of Oxford, Oxford, UK;
[b]Department of Pediatrics, Neuromuscular Reference Center, University and University Hospital of Liège, Liège, Belgium

MALADIES DE CHARCOT-MARIE-TOOTH

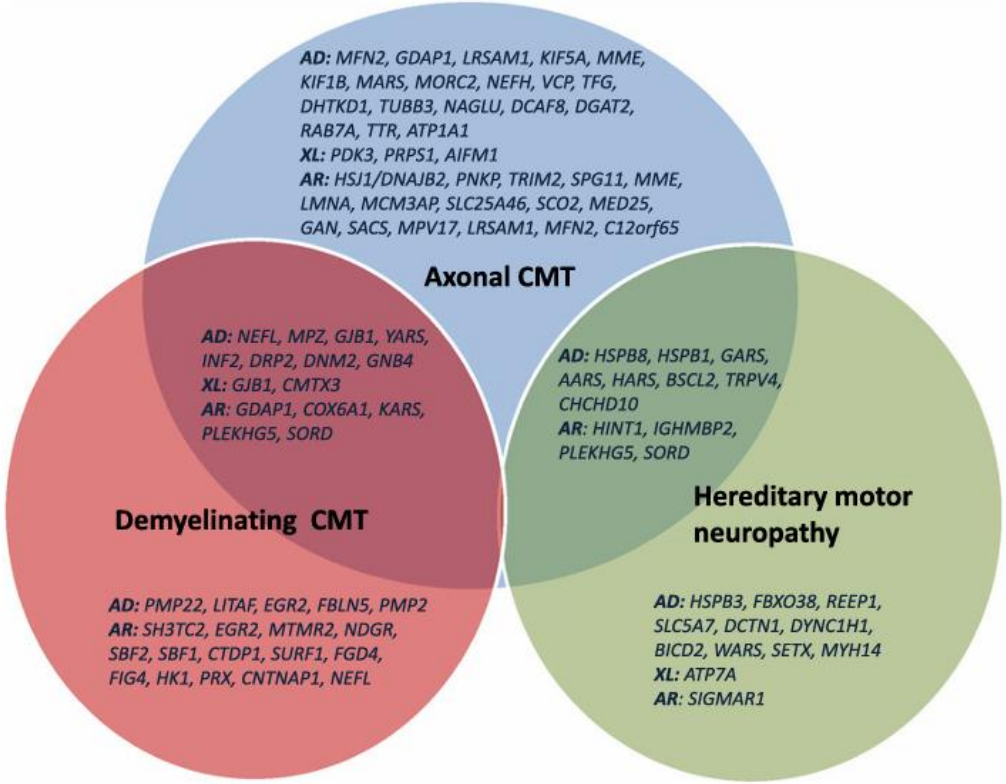
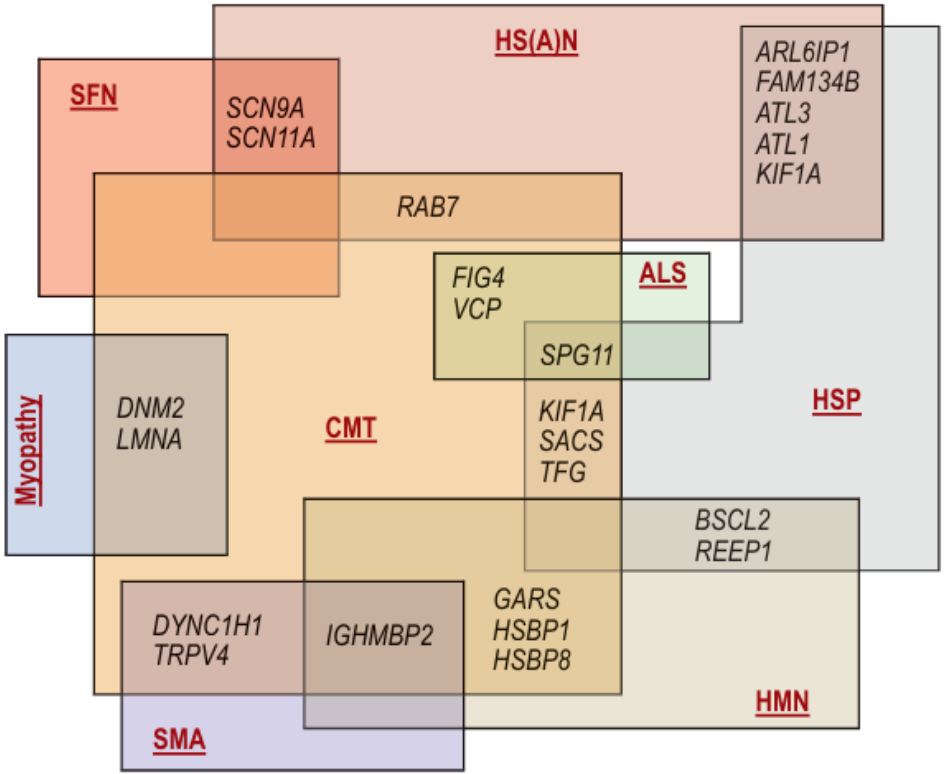


Figure 1: Venn diagram of disease genes for Charcot-Marie-Tooth disease (subdivided into demyelinating and axonal CMT) and distal hereditary motor neuropathy (May 2020). Shaded areas represent overlap phenotypes between subtypes. AD = autosomal dominant, AR = autosomal recessive, XL = X linked.

Hereditary neuropathies: clinical presentation and genetic panel diagnosis

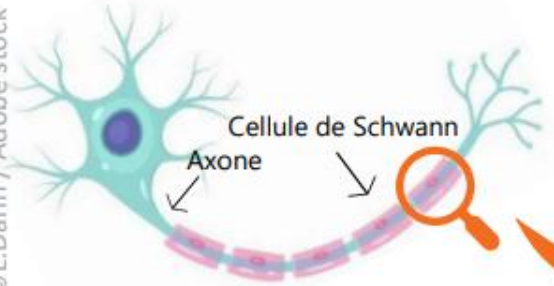
FIGURE 3



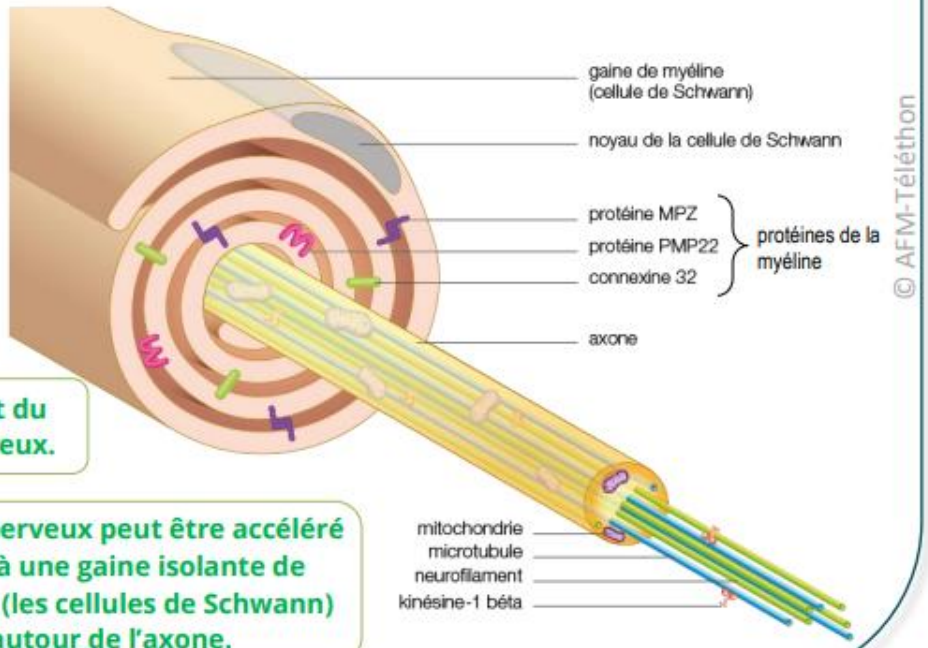
Genetic overlaps among the neuropathies and with other clinical entities.
ALS, amyotrophic lateral sclerosis; CMT, Charcot-Marie-Tooth disease; HMN, hereditary motor neuropathy; HS(A)N, hereditary sensory (and autonomic) neuropathy; HSP, hereditary spastic paraplegia; SFN, small fiber neuropathy; SMA, spinal muscular atrophy

Eggermann K et al. Dtsch Arztebl Int 2018; 115: 91–7

☑ Des lésions génétiquement déterminées des **nerfs périphériques** transmettant les informations nécessaires aux mouvements, aux perceptions (toucher, douleur…), au maintien de l'équilibre…



Le nerf périphérique relie les organes du corps (dont les muscles) au système nerveux central (moelle épinière, cerveau…).



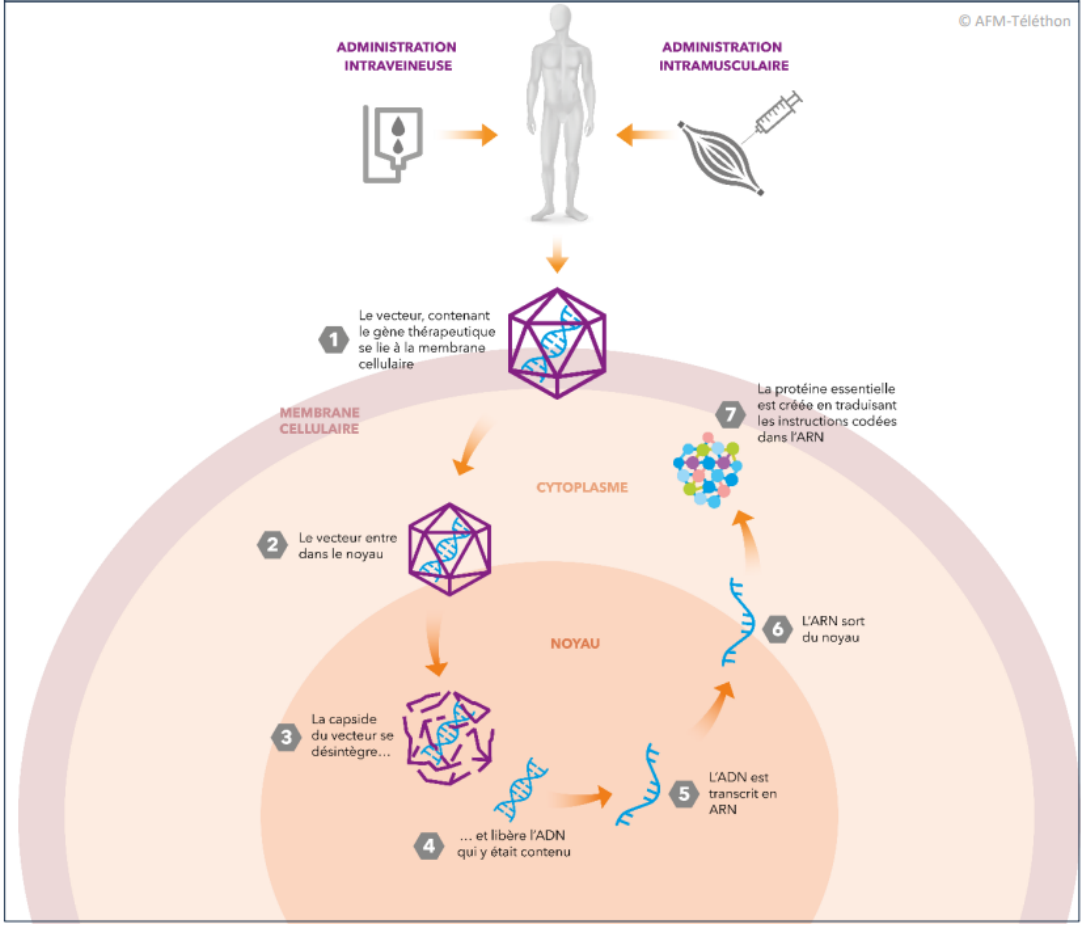
L'axone est le prolongement du nerf qui conduit l'influx nerveux.

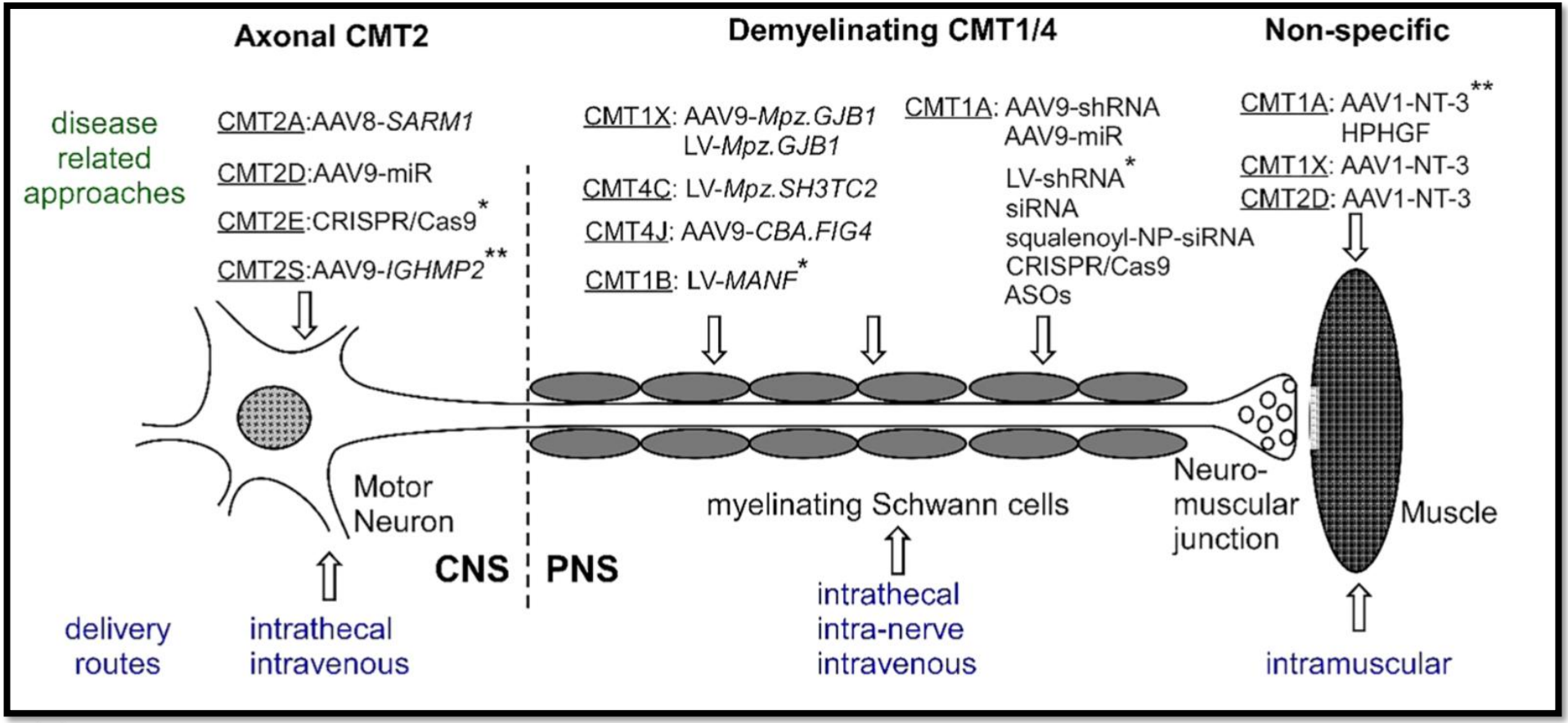
L'influx nerveux peut être accéléré grâce à une gaine isolante de myéline (les cellules de Schwann) autour de l'axone.

PXT 3003 pour CMT1A

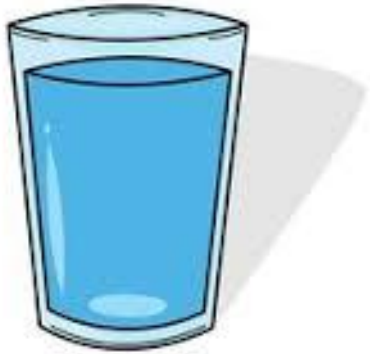
- Résultats initiaux encourageants
  - Mais pas de confirmation dans essai PREMIER

Qu'est-ce que la thérapie génique ?





Stavrou M et al. J Peripher Nerv Syst. 2023;28:150–168



Et puis encore

LA MYASTHÉNIE AUTO-IMMUNE

Généralités

- Rare voire ultra-rare
- Tout âge, adultes >> enfants
- Pédiatrie: prédominance chez filles
- Maladie chronique, évolution variable
  - Début oculaire, généralisation fréquente (en 2-3 ans)
- Rôle génétique (HLA) et thymus

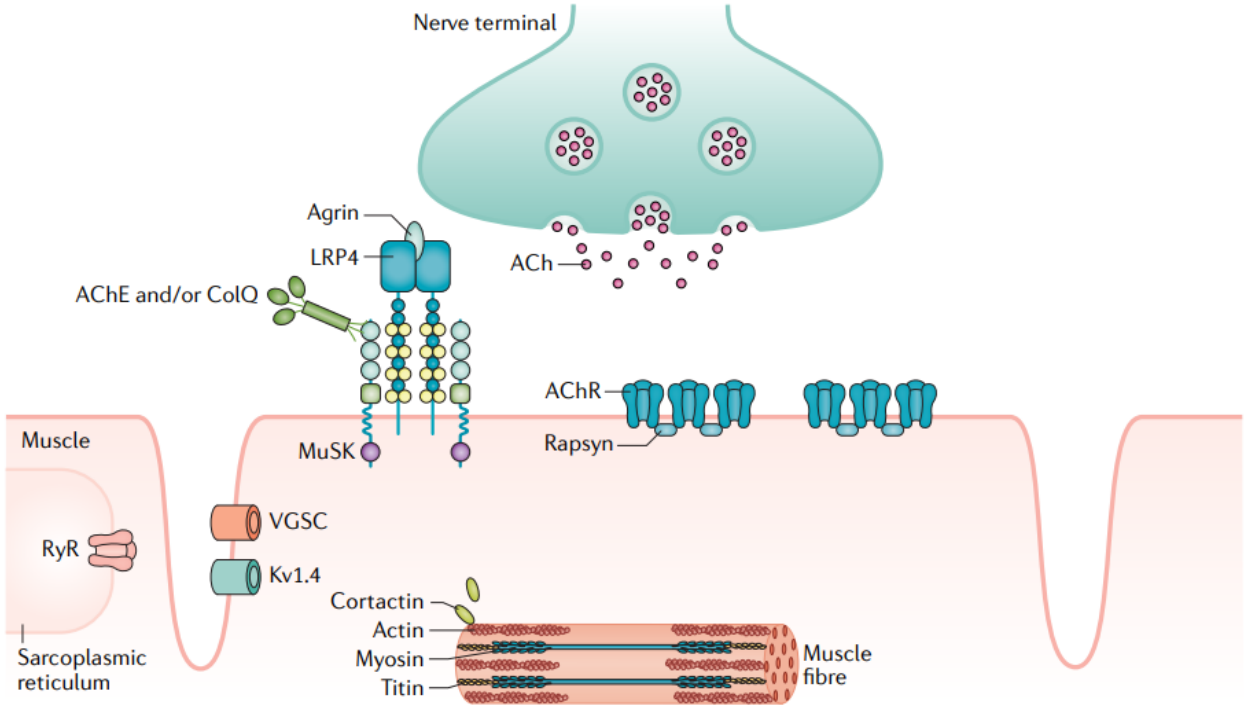


Fig. 1 | **Structure of the neuromuscular junction.** The neuromuscular junction comprises the presynaptic nerve terminal and the postsynaptic muscle cell. Agrin released from the nerve terminal binds to lipoprotein-receptor-related protein 4 (LRP4) and muscle-specific kinase (MuSK), leading to the activation of MuSK, which in turn causes clustering of the acetylcholine (ACh) receptors (AChRs), which is necessary for the maintenance of the postsynaptic structures. AChE, acetylcholinesterase; ColQ, collagen Q; Kv1.4, voltage-gated potassium channel; RyR, ryanodine receptor; VGSC, voltage-gated sodium channel.

https://doi.org/10.1038/s41572-019-0079-y

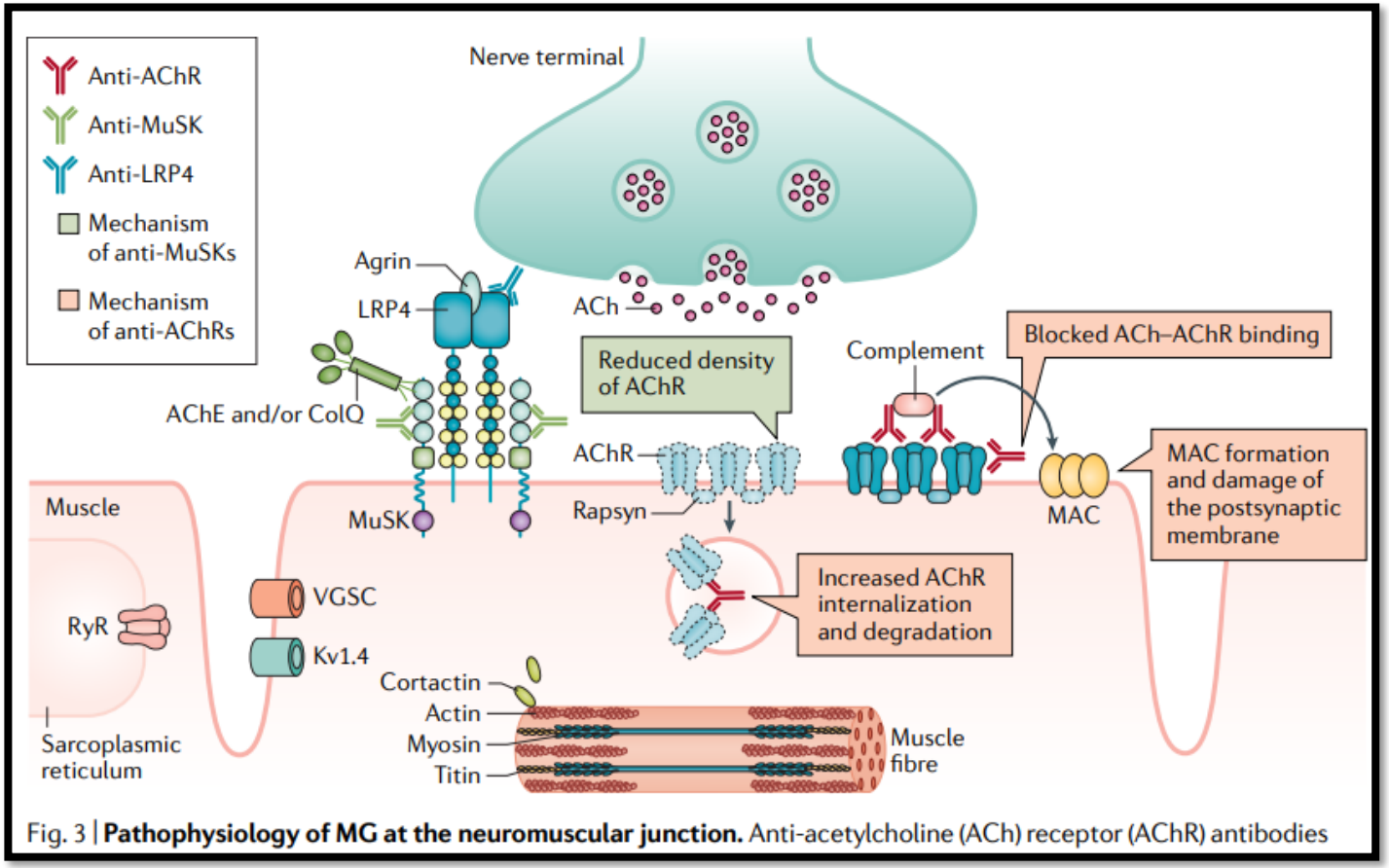
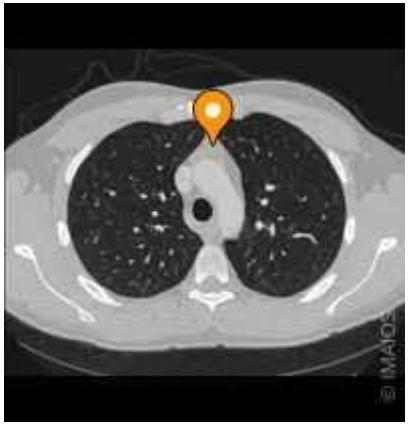
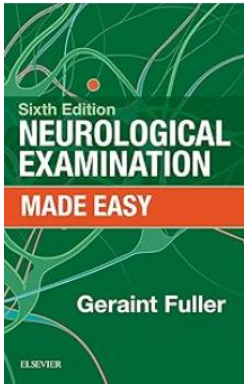


Fig. 3 | **Pathophysiology of MG at the neuromuscular junction.** Anti-acetylcholine (ACh) receptor (AChR) antibodies

https://doi.org/10.1038/s41572-019-0079-y

Diagnostic

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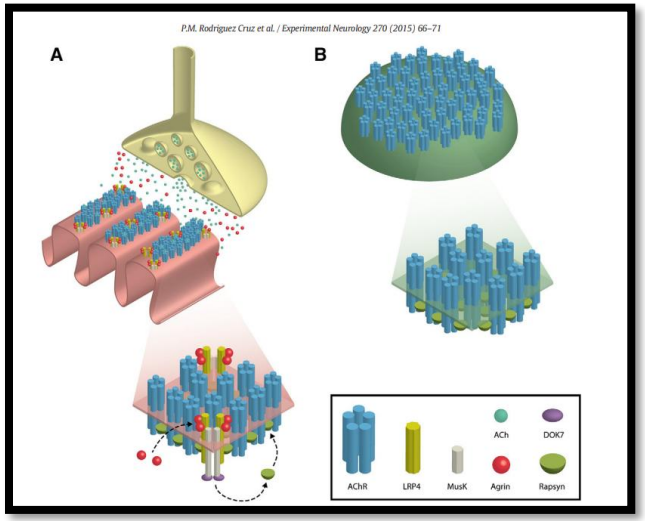
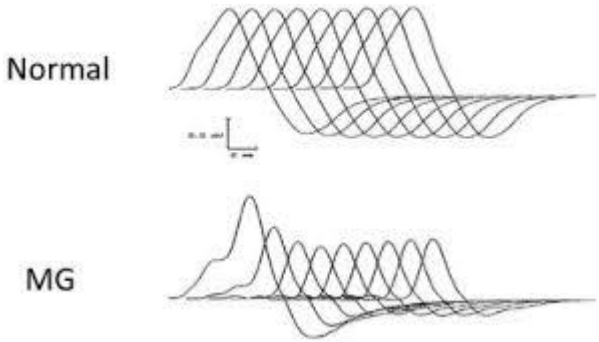
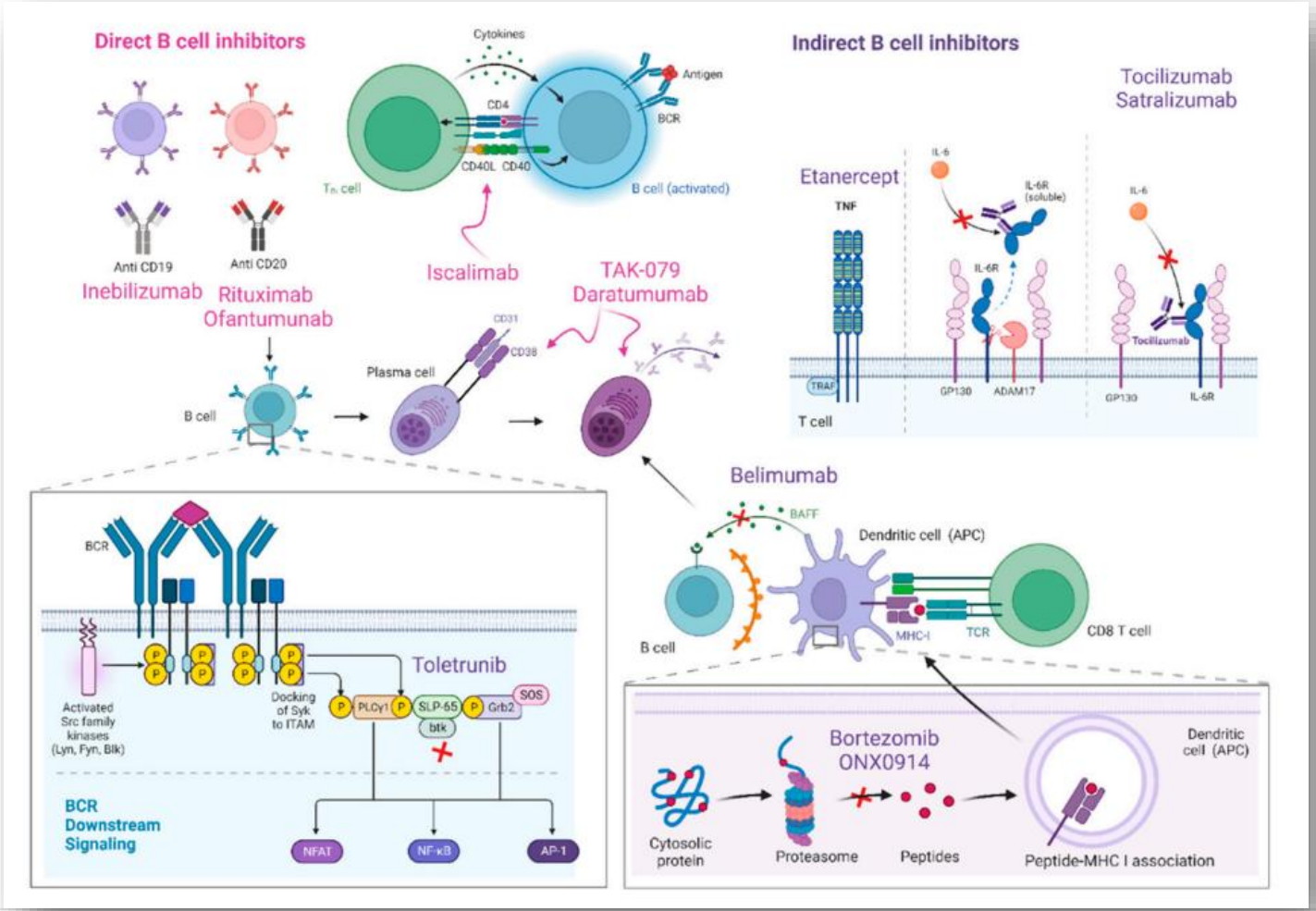

P.M. Rodriguez Cruz et al. / Experimental Neurology 270 (2015) 66–71
A
B
ACh
DOK7
AChR
LRP4
MusK
Agrin
Rapsyn


Normal
MG

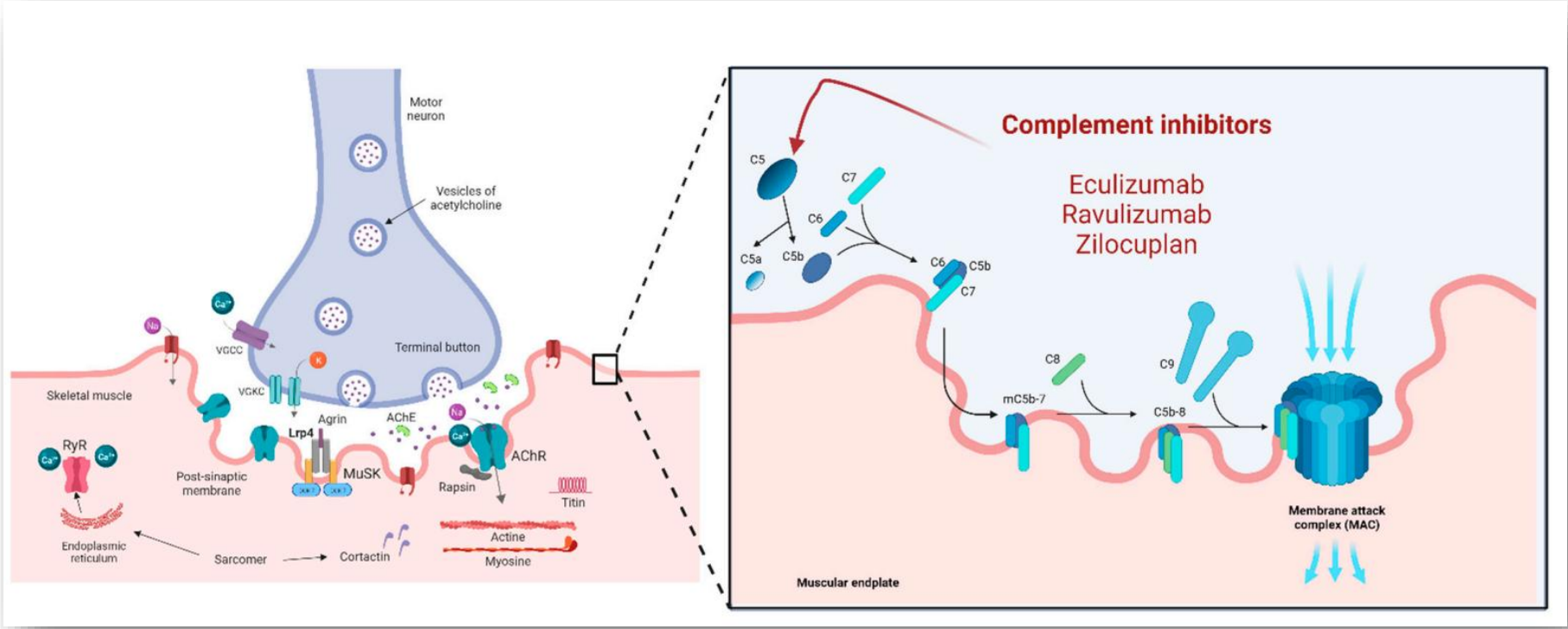
Prise en charge

- Contrôle de la maladie
  - Symptômes +/- immunosuppression
  - Symptômes vs risques/E2°
- Qualité de vie, guérison si possible
- Comorbidités (auto-immunes, psychologiques, douleurs…)

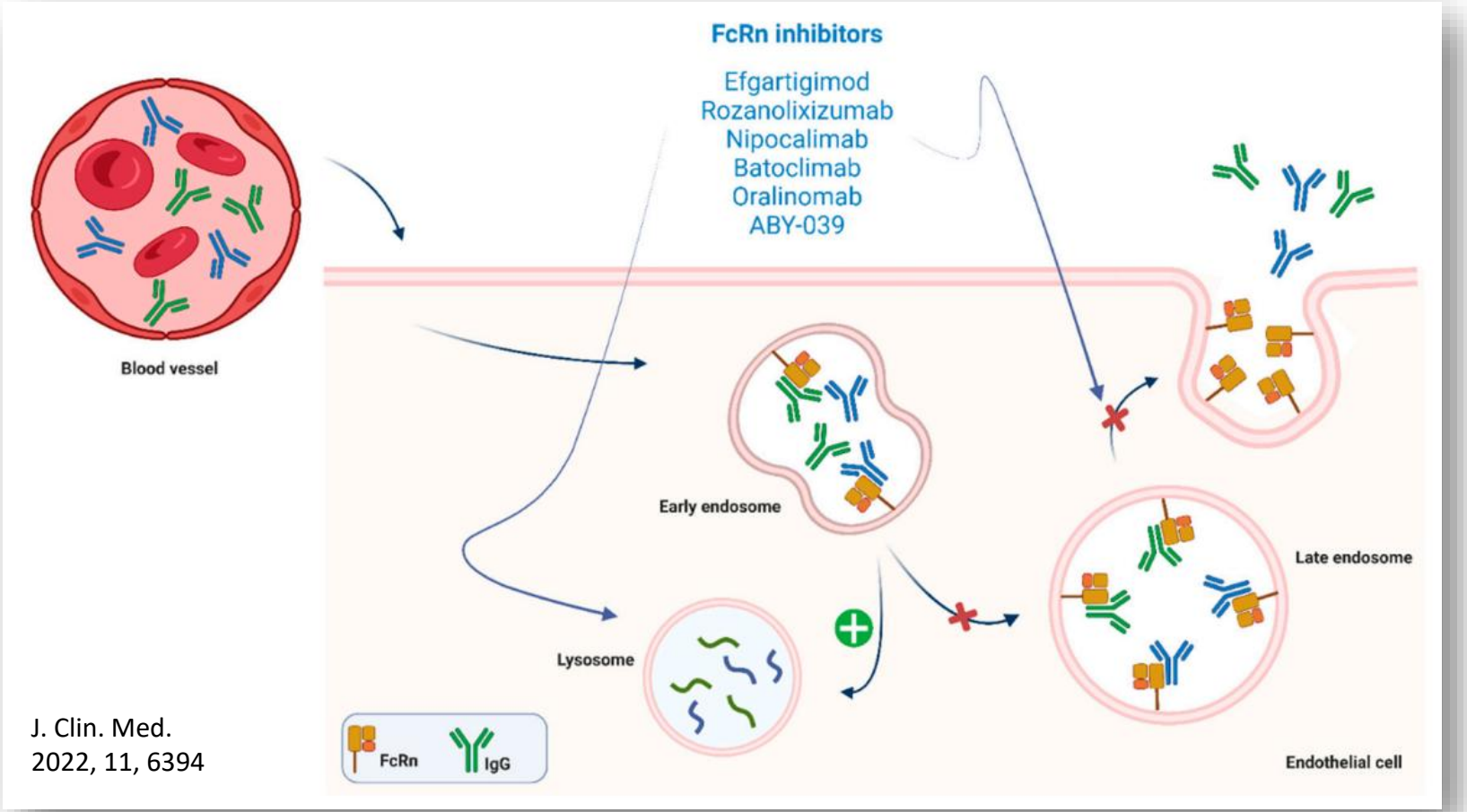
- Symptôme:
  - Pyridostigmine (Mestinon®)
- Immunosuppression:
  - Prednisone, azathioprine
  - autres



J. Clin. Med. 2022, 11, 6394



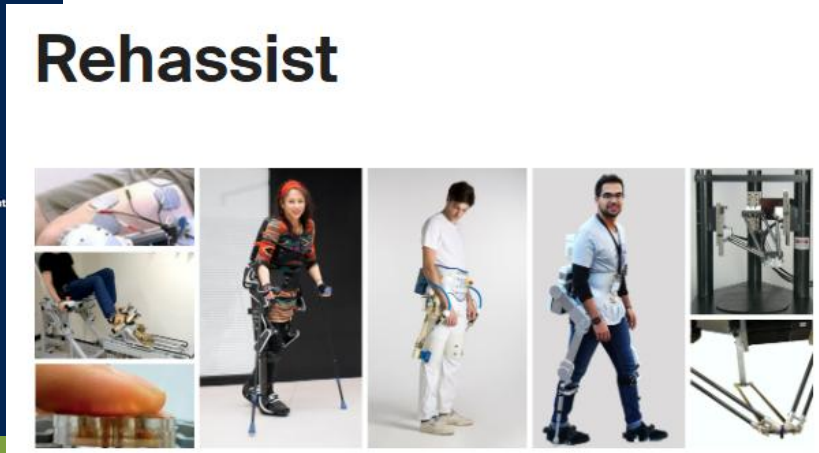
J. Clin. Med.
2022, 11, 6394



J. Clin. Med.
2022, 11, 6394

Et encore…


L'initiative pour l'inclusion est déposée!
Devenez membre de l'association pour une Suisse inclusive et sout
ainsi directement l'initiative pour l'inclusion.
Devenir membre
Pour reçevoir les dernières informations sur le dévélopment de l'initiative abonnez la newsletter.
Abonner la newsletter.
Vous avez raté le dépôt de l'initiative à Berne?
Regardez le Livestream sur Youtube
Photo du comité de l'initiative lors du dépôt. © Monique Wittwer


Rehassist
The research group Rehabilitation and Assistive Robotics – REHAssist– is headed by Dr. Mohamed Bouri.


TELETHON
TABLE RON
Mercredi 27 novembre
En live sur notre chaîne Youtube
Après l'école:
la nébuleuse des parcours de formation
des jeunes à mobilité réduite

Merci pour votre attention!