MALADIES RÉTINIENNES CÉCITANTES À TRANSMISSION HÉRÉDITAIRE

Enjeux cliniques et génétiques

Julien MICHEL, DVM, CES Oph

Journée annuelle de l'AFOV

13 septembre 2025, ENVA

AFOV
Association pour la Formation en Ophtalmologie Vétérinaire

VPLUS
RÉSEAU VÉTÉRINAIRE
SAINT-GERMAIN-EN-LAYE

DÉFINITION

« Les **dystrophies rétiniennes héréditaires** (DRH) sont un groupe de maladies **neurodégénératives** d'origine **génétique** dues à des mutations de gènes qui ont pour conséquences, d'une part, la **dysfonction** d'un type cellulaire rétinien et, d'autre part, la **mort cellulaire** entraînant une **perte progressive de la vision** ».

Les dystrophies rétiniennes héréditaires : apports de la génétique moléculaire

Christian P. Hamel

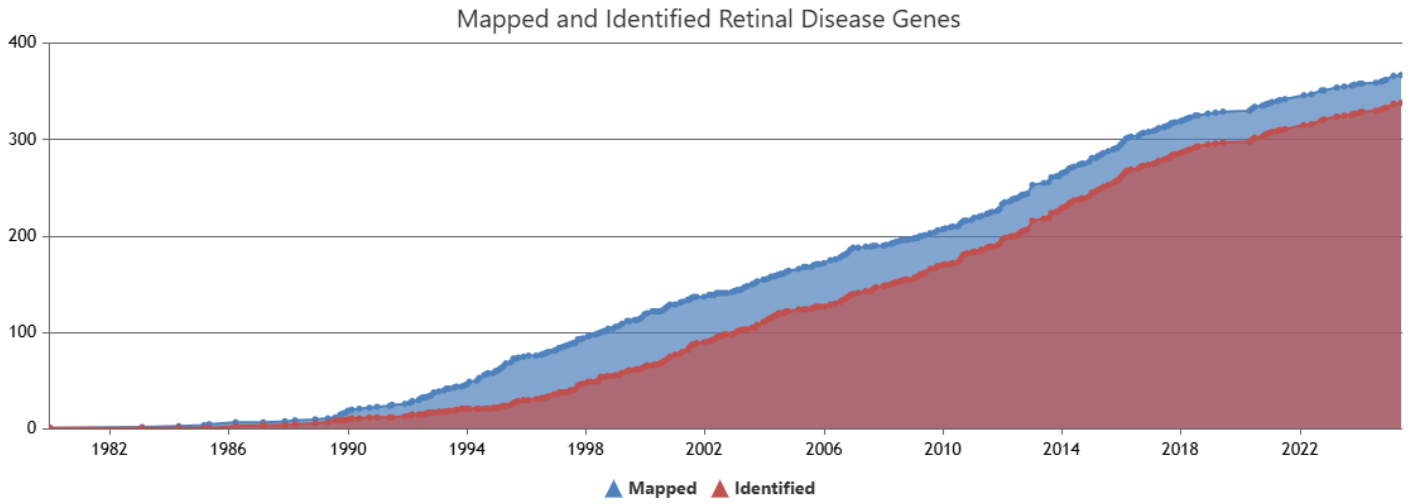
INSERM U.1051, Institut des Neurosciences de Montpellier, Hôpital Saint-Éloi, BP 74103, 80 rue Augustin Fliche, 34091 Montpellier Cedex 5, France

Biologie Aujourd'hui, 207 (2), 73-85 (2013)

DOI: 10.1051/jbio/2013007

UN ESSOR RÉCENT

- Apports de la **génétique moléculaire**



www.retnet.org

Les dystrophies rétiniennes héréditaires : apports de la génétique moléculaire

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Biologie Aujourd'hui, 207 (2), 73-85 (2013)

DOI: 10.1051/jbio/2013007

OPHTALMOLOGIE COMPARÉE

- Intérêt croissant pour les **modèles animaux spontanés**

Bunel, Hum Genet, 2019
Winkler, Cells, 2020
Kostic, J Pathol, 2016

A Large Animal Model for *CNGB1* Autosomal Recessive Retinitis Pigmentosa

Paige A. Winkler[1,2], Kari J. Ekenstedt[3], Laurence M. Occelli[1], Anton V. Frattaroli[4], Joshua T. Bartoe[1], Patrick J. Venta[1,2,5], Simon M. Petersen-Jones[1,2]*

1 Department of Small Animal Clinical Sciences, College of Veterinary Medicine, Michigan State University, East Lansing, Michigan, United States of America, 2 Genetics Program, Michigan State University, East Lansing, Michigan, United States of America, 3 Department of Animal and Food Sciences, University of Wisconsin-River Falls, River Falls, Wisconsin, United States c
Microbiology and Molecular Ge

Citation: Winkler PA, Ekens
Pigmentosa. PLoS ONE 8(8): e

model of *RDH5*-as
mportant features

Gene therapy rescues cone function in congenital achromatopsia

András M. Komáromy[1,*], John J. Alexander[2,3,4], Jessica S. Rowlan[1], Monique M. Garcia[1,5], Vince A. Chiodo[3], Asli Kaya[5], Jacqueline C. Tanaka[5], Gregory M. Acland[6], William W. Hauswirth[2,3] and Gustavo D. Aguirre[1]

[1]Department of Clinical Studies, School of Veterinary Medicine, University of Pennsylvania, Philadelphia, PA 19104, USA, [2]Department of Molecular Genetics and Microbiology and [3]Department of Ophthalmology and Powell Gene Therapy Center, University of Florida, Gainesville, FL 32610, USA, [4]Vision Science Research Center, University of Alabama, Birmingham, AL 35294, USA, [5]Department of Biology, Temple University, Philadelphia, PA 19122, USA and [6]Baker Institute, Cornell University, Ithaca, NY 14853, USA

Crx^{Rdy} Cat: A Large Animal Model for *CRX*-Associated Leber Congenital Amaurosis

Laurence M. Occelli,[1] Nicholas M. Tran,[2] Kristina Narfström,[3] Shiming Chen,[2] and Simon M. Petersen-Jones[1]

[1]Small Animal Clinical Sciences, Michigan State University, East Lansing, Michigan, United States
[2]Ophthalmology and Visual Sciences, Washington University School of Medicine, St. Louis, Missouri, United States
[3]Department of Veterinary Medicine and Surgery, University of Missouri-Columbia, Columbia, Missouri, United States

Molecular Ther
Original Article

Human Molecular Genetics, 2010, Vol. 19, No. 13

6β-deficient Dog, a Large Animal Model of Rod-cone Dystrophy

t[1], Elsa Lhériteau[1], Michel Weber[2], Guylène Le Meur[2], Jack-Yves Deschamps[3], Nathalie Provost[1], Mendes-Madeira[1], Lyse Libeau[1], Caroline Guihal[1], Marie-Anne Colle[4], Philippe Moullier[1,5] nne Rolling[1]

Development of a translatable gene augmentation therapy for *CNGB1*-retinitis pigmentosa

IOVS | July 2016 | Vol. 57 | No. 8 | 3781

Laurence M. Occelli,[1] Lena Zobel,[2,3] Jonathan Stoddard,[4] Johanna Wagner,[2] Lauren M. Renner,[4] Rene Reynaga,[4] Paige A. Winkler,[1] Kelian Sun,[1] Luis Catherine R. O'Riordan,[5] Amy Frederick,[5] Andreas Lauer,[6] Stephen H. Ts Trevor J. McGill,[4,6] Martha Neuringer,[4,6] Stylianos Michalakis,[2,3] and Sim

A Naturally Occurring Canine Model of Autosomal Recessive Congenital Stationary Night Blindness

Mineo Kondo[1]*, Gautami Das[2], Ryoetsu Imai[3], Evelyn Santana[2], Tomio Nakashita[3], Miho Imawaka[3], Kosuke Ueda[3], Hirohiko Ohtsuka[3], Kazuhiko Sakai[4], Takehiro Aihara[4], Kumiko Kato[1], Masahiko Sugimoto[1], Shinji Ueno[5], Yuji Nishizawa[6], Gustavo D. Aguirre[2]*, Keiko Miyadera[2]

n Gene Mutations Cause Canine Multifocal hy: A Novel Animal Model for Best Disease

wicz,[1] Barbara Zangerl,[1] Sarah J. Lindauer,[1] Robert F. Mullins,[2] eyer,[3] Bruce H. Grahn,[3] Edwin M. Stone,[2,4] Gregory M. Acland,[5] and Gustavo D. Aguirre[1]

Assessmen Augmentation in the Canine Model of Autosomal Dominant R

PLOS ONE | DOI:10.1371/journal.pone.0137072 September 14, 2015

gene therap
childhood bl

IOVS, May 2007, Vol. 48, No. 5

Safety and Efficacy Evaluation of rAAV2tYF-PR1.7-hCNGA3 Vector Delivered by Subretinal Injection in CNGA3 Mutant Achromatopsia Sheep

Elisha Gootwine, Ron Ofri, Eyal Banin, Alexey Obolensky, Edward Averbukh, Raaya Ezra-Elia, Maya Ross, Hen Honig, Alexander Rosov, Esther Yamin, Guo-jie Ye, David R. Knop, Paulette M. Robinson, Jeffrey D. Chulay, and Mark S. Shearman

Human Gene Therapy Clinical Development. Jun 2017. 96-107.
http://doi.org/10.1089/humc.2017.028

BEST1 gene therapy corrects a diffuse retina-wide microdetachment modulated by light exposure

tur V. Cideciyan, cobson, William W.

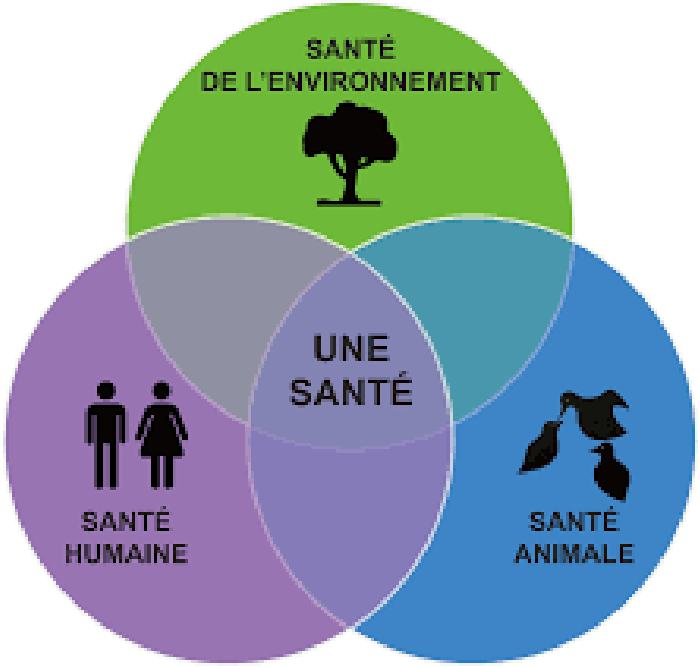
Karina E. Guziewicz[a,1,2], Artur V. Cideciyan[b,1,2], William A. Beltran[a], András M. Komáromy[a,c], Valerie L. Dufour[a], Malgorzata Swider[b], Simone Iwabe[a], Alexander Sumaroka[b], Brian T. Kendrick[a], Gordon Ruthel[d], Vince A. Chiodo[a], Elise Héon[f], William W. Hauswirth[a], Samuel G. Jacobson[b], and Gustavo D. Aguirre[a]

[a]Division of Experimental Retinal Therapies, Department of Clinical Sciences and Advanced Medicine, School of Veterinary Medicine, University of Pennsylvania, Philadelphia, PA 19104; [b]Scheie Eye Institute, Department of Ophthalmology, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA 19104; [c]Department of Small Animal Clinical Sciences, College of Veterinary Medicine, Michigan State University, East Lansing, MI 48824; [d]Department of Pathobiology, School of Veterinary Medicine, University of Pennsylvania, Philadelphia, PA 19104; [e]Department of Ophthalmology, College of Medicine, University of Florida, Gainesville, FL 32611; and [f]Department of Ophthalmology and Vision Sciences, The Hospital for Sick Children, University of Toronto, Toronto, ON M5G 2L3, Canada

Bunel, Hum Genet, 2019
Winkler, Cells, 2020
Kostic, J Pathol, 2016

“UNE SEULE SANTÉ”

- **Enjeux mutuels** pour la médecine humaine et vétérinaire



PLAN

1. DRH humaines et animales : regards croisés
2. La promesse des modèles spontanés de DRH animales
3. Les enjeux d'*une seule santé*

01

DRH humaines et animales : regards croisés

HISTORIQUE

1911, Magnusson

Description phénotypique

Magnusson, Arch Verg Ophthalmol, 1911
Suber, Proc Natl Acad Sci 1993
Mowat, Vet Oph, 2024

HISTORIQUE

1911, Magnusson

Description phénotypique

1993, Suber

1ère identification génétique (PDE6B)

Magnusson, Arch Verg Ophthalmol, 1911
Suber, Proc Natl Acad Sci 1993
Mowat, Vet Oph, 2024

HISTORIQUE

1911, Magnusson

Description phénotypique

1993, Suber

1ère identification génétique

2023

Gènes identifiés
CN : 45
CT : 5
CV : 3

Magnusson, Arch Verg Ophthalmol, 1911
Suber, Proc Natl Acad Sci 1993
Mowat, Vet Oph, 2024

UNE RÉVOLUTION EN MARCHE…

1911, Magnusson

Description phénotypique

1993, Suber

1ère identification génétique

2023

Gènes identifiés
CN : 45
CT : 5
CV : 3

Magnusson, Arch Verg Ophthalmol, 1911
Suber, Proc Natl Acad Sci 1993
Mowat, Vet Oph, 2024

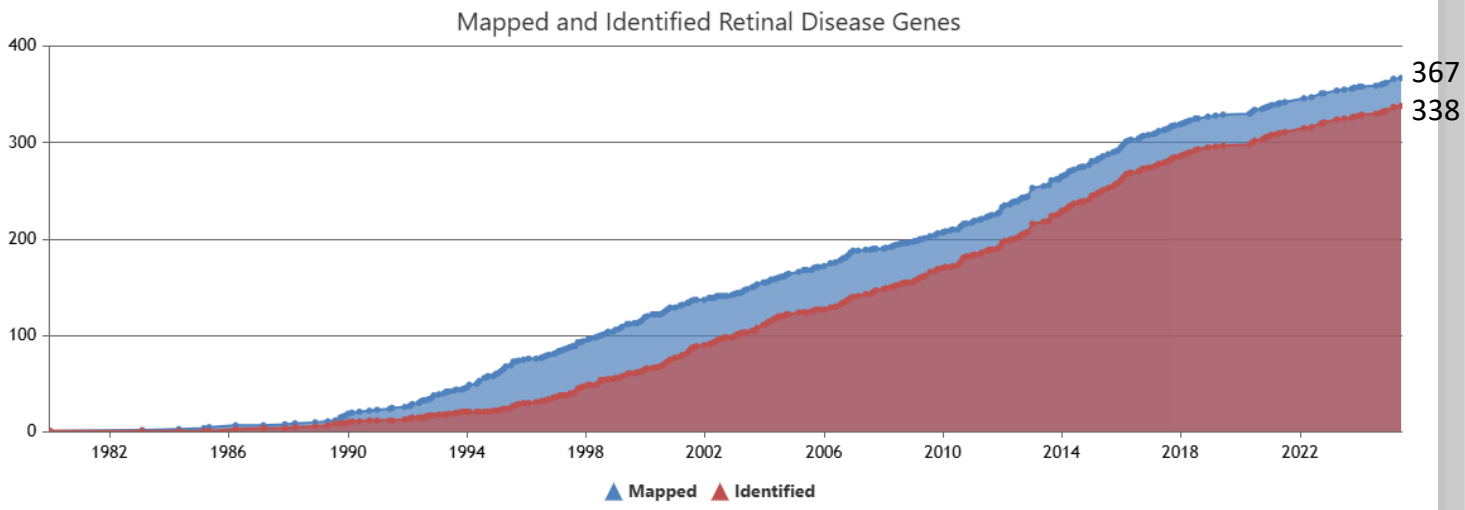
DRH HUMAINES ET ANIMALES : REGARDS CROISÉS

MÉTHO

nol, 1911
Sci 1993
Mowat, Vet Oph, 2024

…GRÂCE À L'ESSOR DES MÉTHODES D'INVESTIGATION

- Apports de la **génétique moléculaire**



« Un même phénotype est souvent causé par des mutations de gènes très différents »

www.retnet.org

Les dystrophies rétiniennes héréditaires : apports de la génétique moléculaire

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Biologie Aujourd'hui, 207 (2), 73-85 (2013)

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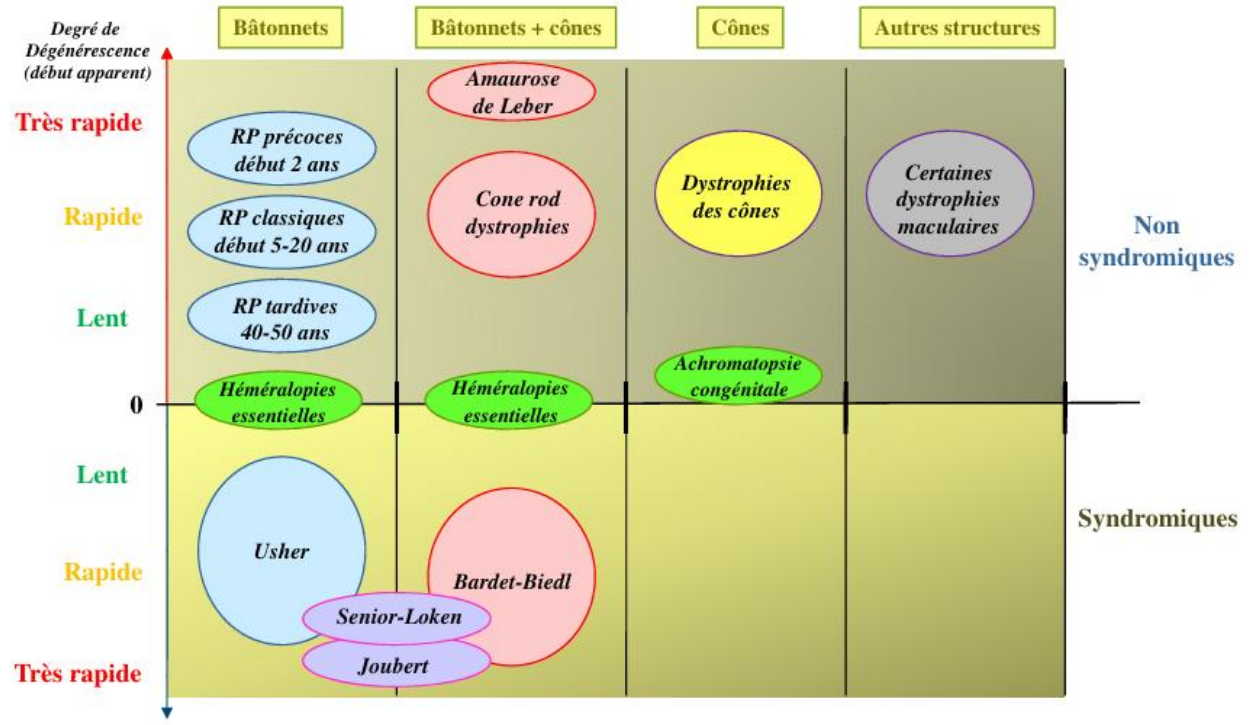
CLASSIFICATION DES DRH HUMAINES



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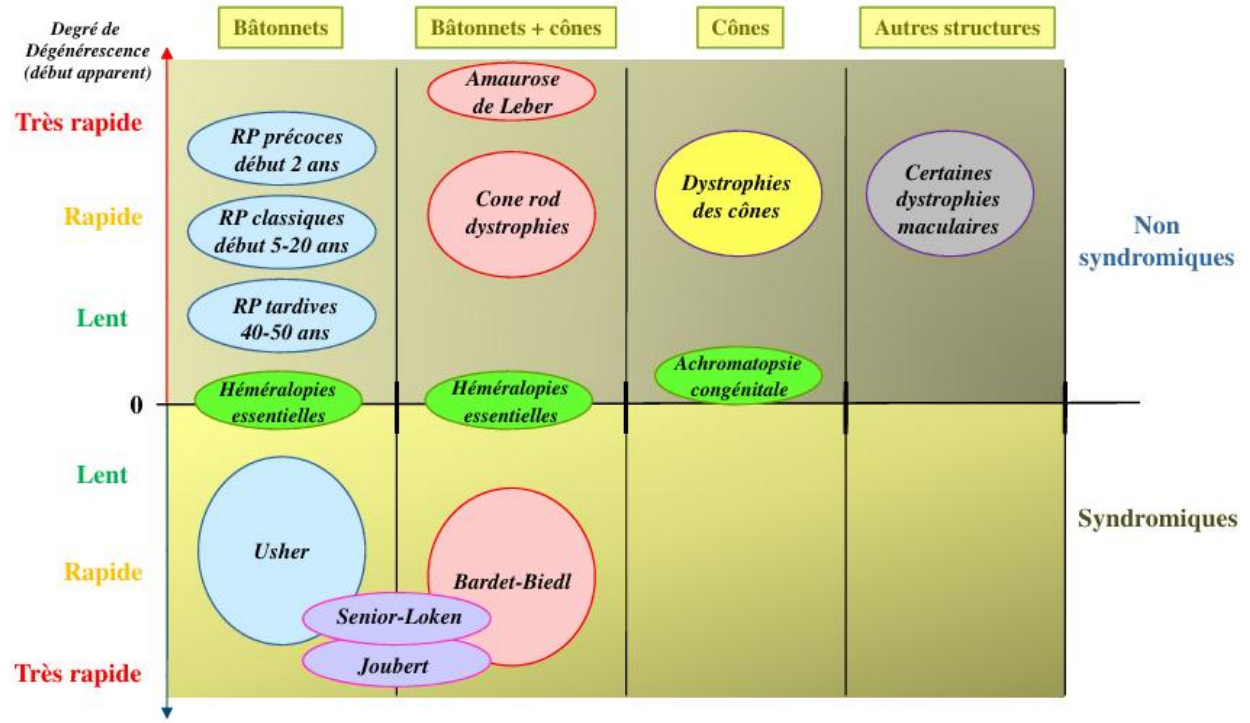

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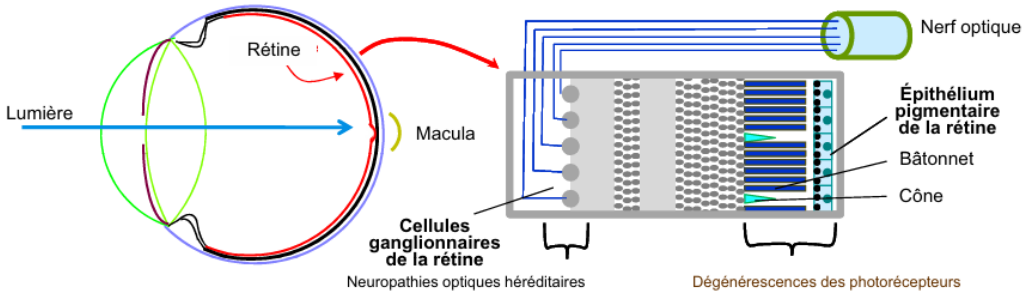
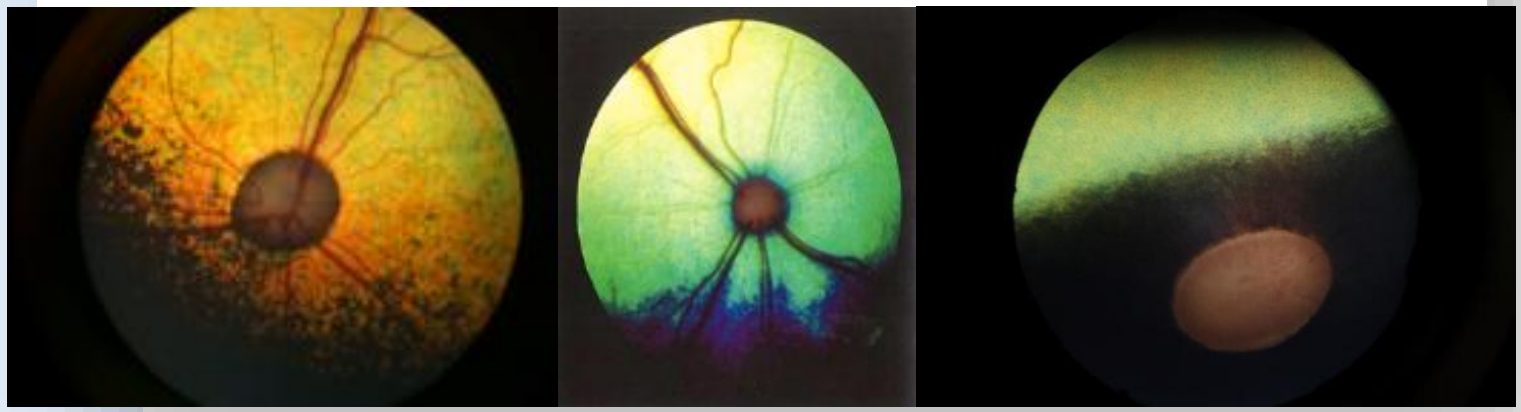


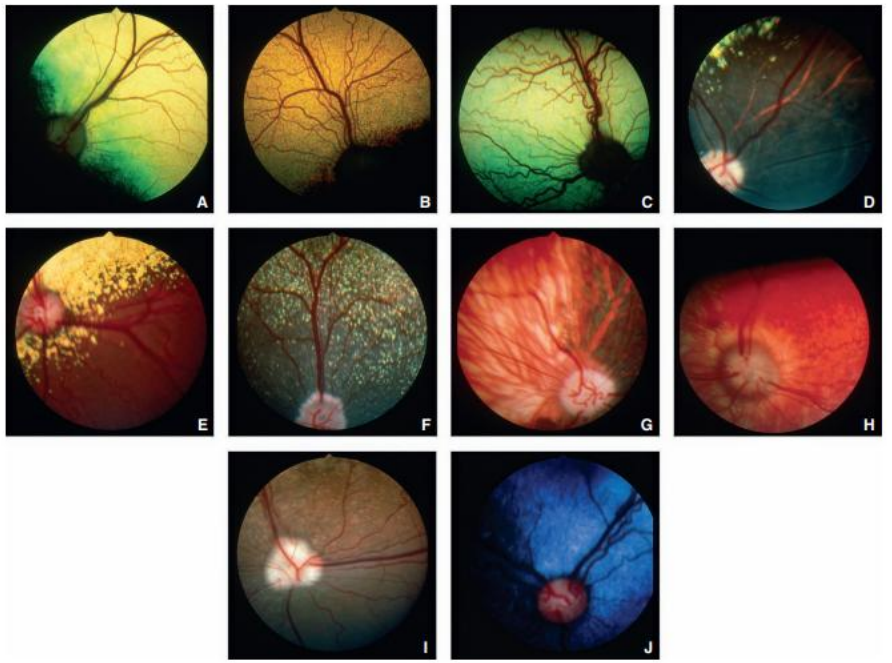
DIAGNOSTIC DES DRH ANIMALES

- Défi diagnostique : patient « non-parlant »
  - ➢ Symptômes cliniques tardifs
  - ➢ Hétérogénéité interspécifique du fond d'œil
    - ✓ Vascularisation rétinienne



DIAGNOSTIC DES DRH ANIMALES

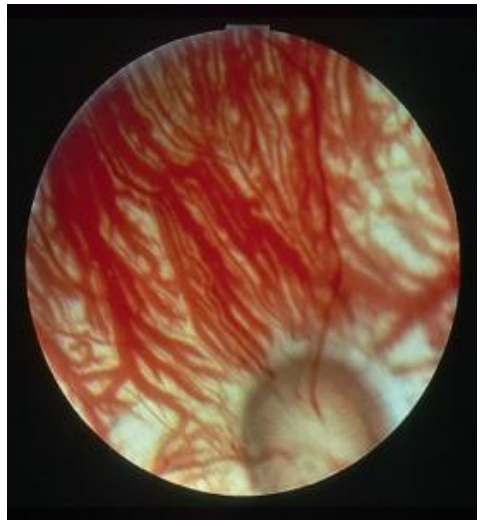
- Défi diagnostique : patient « non-parlant »
  - ➢ Symptômes cliniques tardifs
  - ➢ Hétérogénéité intraspécifique du fond d'œil
    - ✓ Tapis choroïdien

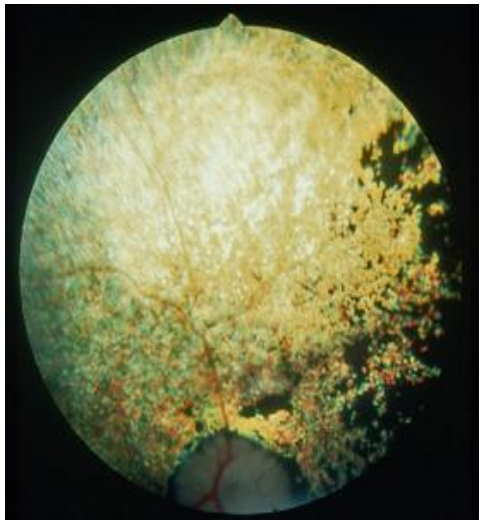


Petersen-Jones, Vet Ophth, 2021

DIAGNOSTIC DES DRH ANIMALES

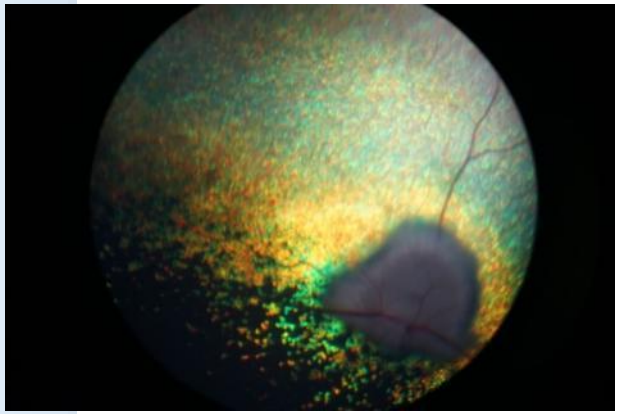
- Défi diagnostique : patient « non-parlant »
  - Symptômes cliniques tardifs
  - Hétérogénéité du fond d'œil

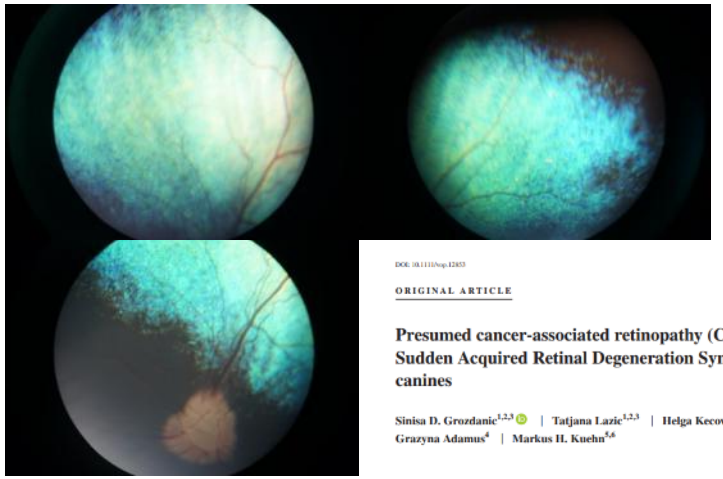




DIAGNOSTIC DES DRH ANIMALES

- Défi diagnostique : patient « non-parlant »
  - ➢ Symptômes cliniques tardifs
  - ➢ Hétérogénéité du fond d'œil
  - ➢ Phénocopies





ORIGINAL ARTICLE

WILEY

Presumed cancer-associated retinopathy (CAR) mimicking Sudden Acquired Retinal Degeneration Syndrome (SARDS) in canines

Sinisa D. Grozdanic[1,2,3] | Tatjana Lazic[1,2,3] | Helga Kecova[1,2] | Kabhilan Mohan[1] | Grazyna Adamus[4] | Markus H. Kuehn[5,6]

Atrophie Progressive de la Rétine (APR-prcd)

Résultat : **Homozygote normal**

Interprétation : L'animal possède deux copies normales du gène PRCD. L'animal ne développera pas l'Atrophie Progressive de la Rétine associée à la mutation testée. L'animal ne transmettra pas la mutation à sa descendance.

ORIGINAL ARTICLE

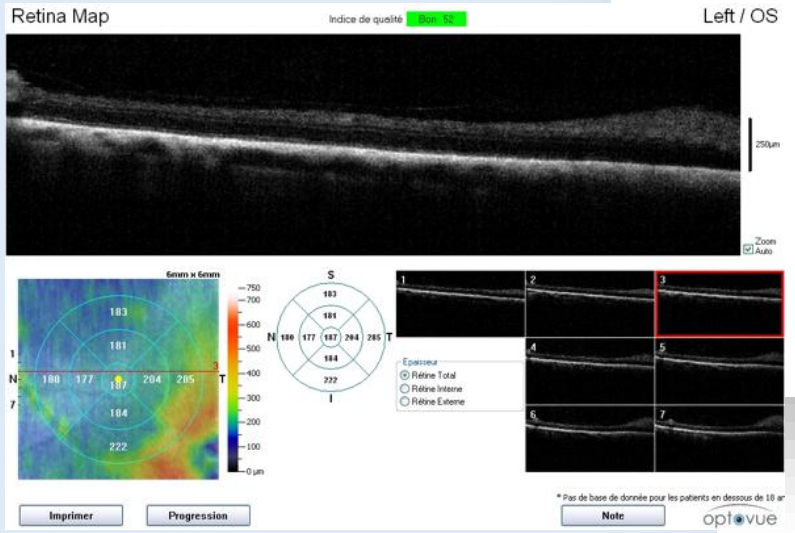
WILEY

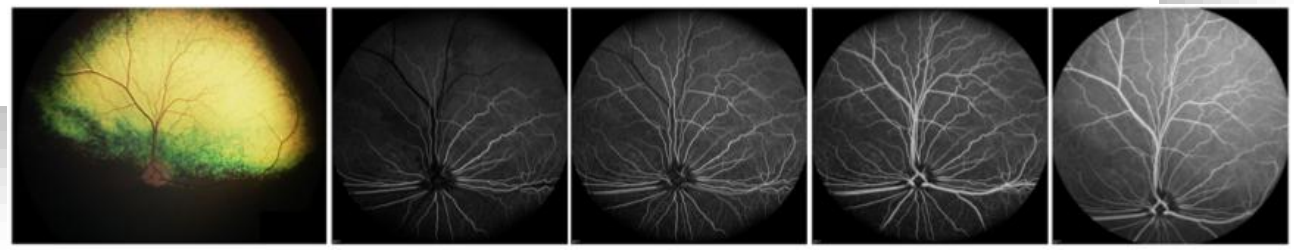
Optical coherence tomography and molecular analysis of sudden acquired retinal degeneration syndrome (SARDS) eyes suggests the immune-mediated nature of retinal damage

Sinisa D. Grozdanic[1,2,3] | Tatjana Lazic[1,2,3] | Helga Kecova[1,2] | Kabhilan Mohan[1] | Markus H. Kuehn[4]

DIAGNOSTIC DES DRH ANIMALES

- Défi diagnostique : patient « non-parlant »
  - ➢ Symptômes cliniques tardifs
  - ➢ Hétérogénéité du fond d'œil
  - ➢ Phénocopies
  - ➢ Limites techniques





CLASSIFICATION DES DRH ANIMALES

- Classification historique basée sur des critères phénotypiques
  - ➢ Appellation générique : « atrophie rétinienne progressive » (ARP)
    - ✓ ARP généralisées : modèles de rétinite pigmentaire
    - ✓ ARP centrales : dystrophies de l'EPR

CLASSIFICATION DES DRH ANIMALES

- Confusion sémantique
  - ➢ Cécité nocturne stationnaire congénitale chez le Briard
    - ✓ *RPE65* - modèle de l'Amaurose Congénitale de Leber de type 2 (LCA2)
  - ➢ Dystrophie cône – bâtonnet chez l'American Staffordshire terrier
    - ✓ *PDE6b, rcd1b* – modèle de rétinite pigmentaire (RP40) : dystrophie bâtonnet – cône

The Briard dog: a new animal model of congenital stationary night blindness

KRISTINA NARFSTRÖM, ANDERS WRIGSTAD, AND SVEN ERIK G NILSSON

From the Department of Ophthalmology, University of Linköping, S-581 85 Linköping, and Department of Surgery and Medicine, Faculty of Veterinary Medicine, Swedish University of Agricultural Sciences, S-750 07 Uppsala, Sweden

British Journal of Ophthalmology, 1989, **73**, 750–756

CLASSIFICATION DES DRH ANIMALES

- Classification moderne standardisée
  - Mode de transmission
  - Phénotype
  - Génotype
  - Race
  - Appellation historique

TABLE 3 Acronyms and guidelines for application for heritable retinal diseases.

	Category	Subcategory	Phene acronym
Inheritance pattern	Unknown or autosomal recessive	NA	None
	Autosomal dominant (high penetrance)	NA	AD
	X-Linked	NA	XL
Progression	Unknown but inherited (inherited retinal disorder)	NA	IRD
	Stationary blindness – heritable vision changes but nonprogressive	NA	SB
		Cone pathway dysfunction (achromatopsia)	ACH
		Rod pathway dysfunction (stationary night blindness)	SNB
	Heritable, progressive, diffuse, bilateral, and relatively symmetrical	NA	PRA
Idiosyncratic, syndromic, or affecting multiple ophthalmic sites	Collie Eye Anomaly	NA	CEA
	Multiple Ocular Defects (involving the retina)	NA	MOD
	Retinal dysplasia	NA	DYSP

Mowat, Vet Oph, 2024

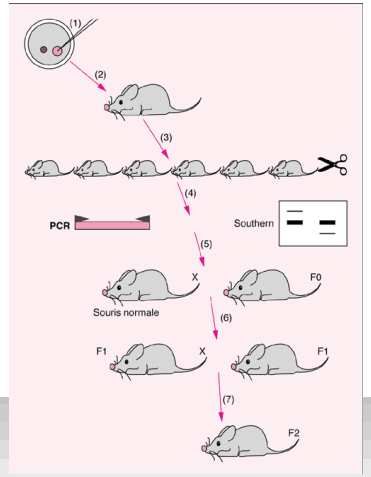
Exemples :
IRD- *BEST1*- Coton de Tulear (cmr2)
XLPRA- *RPGR*- Siberian Husky (XLPRA1)
DYSP- *COL9A2*- Samoyed (osd2)

02

La promesse des modèles spontanés de DRH animales

LES MODÈLES ANIMAUX

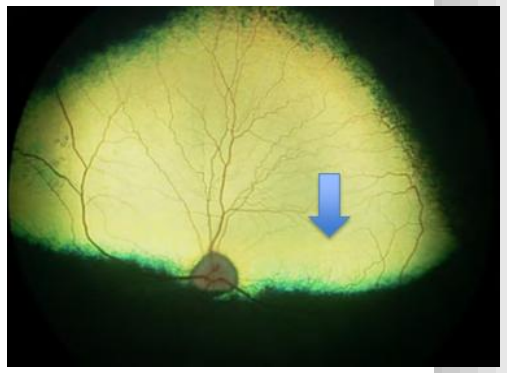
- Conditions *in vivo*
  - ➢ Recherche fondamentale
  - ➢ Essais cliniques thérapeutiques
- Modèles transgéniques (OGM)
- Modèles spontanés



Acland, Mol Ther 2005
Bunel, Hum Gen 2019
Kostic J.pathol 2016
Petersen-Jones, Hum Gene Ther 2015

LES MODÈLES “ GRANDS ANIMAUX”

- **Avantages** :
  - Dimension du globe oculaire
  - Présence d’une *area centralis*
  - Proximité génétique avec l’Homme
- **Inconvénients** :
  - Nombre
  - Temps
  - Coût



Canine Retina Has a Primate Fovea-Like Bouquet of Cone Photoreceptors Which Is Affected by Inherited Macular Degenerations

William A. Beltran[1]*, Artur V. Cideciyan[2]*, Karina E. Guziewicz[1], Simone Iwabe[1], Malgorzata Swider[2], Erin M. Scott[1], Svetlana V. Savina[1], Gordon Ruthel[3], Frank Stefano[4], Lingli Zhang[5], Richard Zorger[5], Alexander Sumaroka[2], Samuel G. Jacobson[2], Gustavo D. Aguirre[1]

1 Department of Clinical Studies, School of Veterinary Medicine, University of Pennsylvania, Philadelphia, Pennsylvania, United States of America, 2 Department of Ophthalmology, Scheie Eye Institute, Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania, United States of America, 3 Department of Pathobiology, School of Veterinary Medicine, University of Pennsylvania, Philadelphia, Pennsylvania, United States of America, 4 Department of Biochemistry, School of Dental Medicine, University of Pennsylvania, Philadelphia, Pennsylvania, United States of America, 5 Department of Neuroscience, Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania, United States of America

Winkler, Cells, 2020

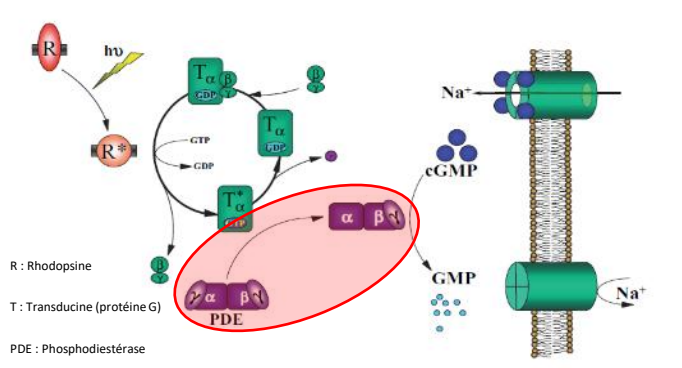
LES MODÈLES SPONTANÉS DE DRH ANIMALES

Mécanismes et gènes identifiés

- La phototransduction
- Le cycle visuel
- Les canalopathies
- Les ciliopathies
- Le développement des photorécepteurs
- Les échanges synaptiques
- Divers

LES MODÈLES SPONTANÉS DE DRH ANIMALES

La phototransduction



Principles and Practice of Clinical Electrophsyiology of Vision, 2nd Ed

La phosphodiestérase

PDE6B : rcd1, rcd1a, rcd1b - modèle RP40

Sloughi (rcd1a)

American Staffordshire terrier (rcd1b)

Irish setter dogs affected with rod/cone dysplasia contain a nonsense mutation in the rod cGMP phosphodiesterase β-subunit gene

MICHAEL L. SUBER*†, STEVEN J. PITTLER‡§, NING QIN¶, GAIL C. WRIGHT‡, VIEN HOLCOMBE†, REHWA H. LEE‖, CHERYL M. CRAFT**, RICHARD N. LOLLEY‖, WOLFGANG BAEHR‡¶††, AND RICHARD L. HURWITZ†‡,‡‡

*College of Optometry, University of Houston, Houston, TX 77204; Departments of ‡Ophthalmology, ¶Biochemistry, †Pediatrics, and ‡‡Cell Biology, Baylor College of Medicine, Houston, TX 77030; ‖Department of Anatomy and Cell Biology, University of California School of Medicine, Los Angeles, CA 90024, and Developmental Neurology Laboratories, Veterans Administration Medical Center, Sepulveda, CA 91343; and **Department of Psychiatry, University of Texas Southwest Medical Center, and Veterans Administration Medical Center, Dallas, TX 75235

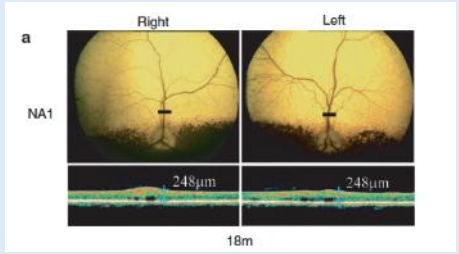
Proc. Natl. Acad. Sci. USA
Vol. 90, pp. 3968–3972, May 1993
Genetics

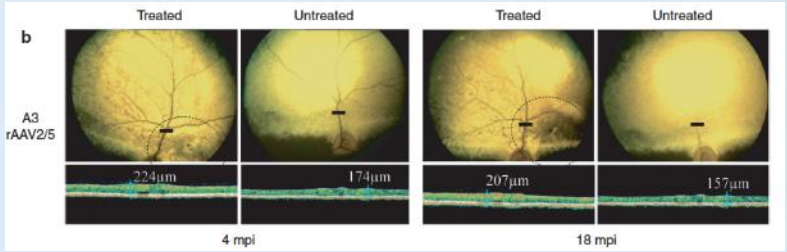
Restoration of Vision in the pde6β-deficient Dog, a Large Animal Model of Rod-cone Dystrophy

Lolita Petit[1], Elsa Lhériteau[1], Michel Weber[2], Guylène Le Meur[2], Jack-Yves Deschamps[3], Nathalie Provost[1], Alexandra Mendes-Madeira[1], Lyse Libeau[1], Caroline Guihal[1], Marie-Anne Colle[4], Philippe Moullier[1,5] and Fabienne Rolling[1]

Molecular Therapy vol. 20 no. 11, 2019–2030 nov. 2012

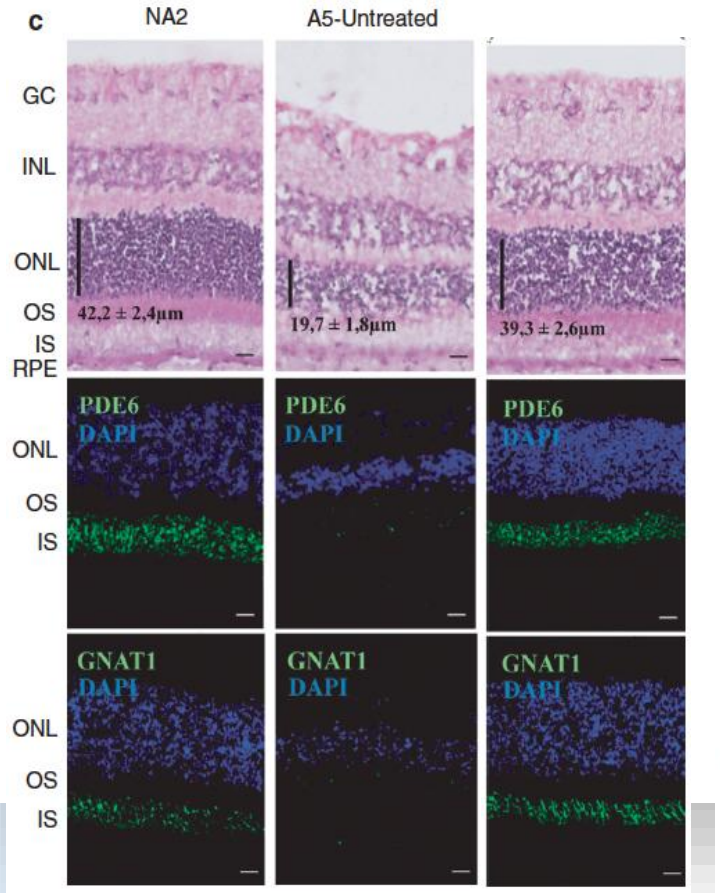
LES MODÈLES SPONTANÉS DE DRH ANIMALES

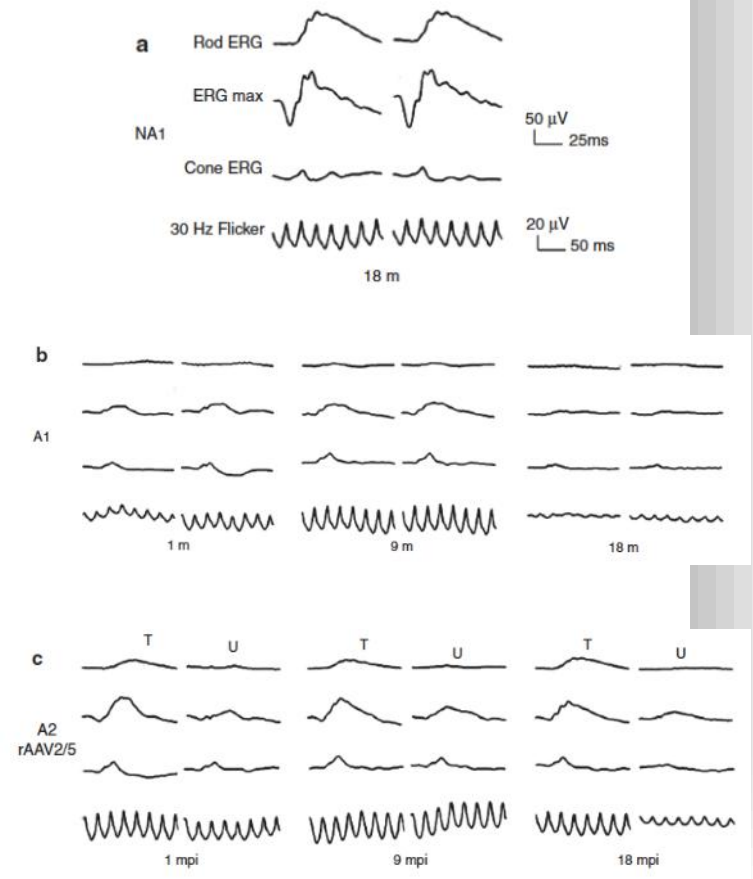




La phosphodiestérase

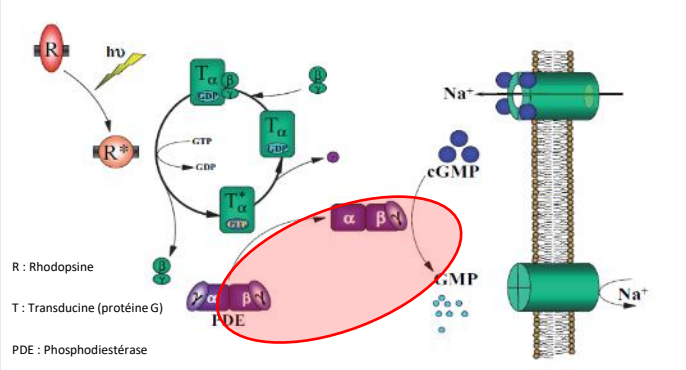
PDE6B : rcd1, rcd1a, rcd1b - modèle RP40





LES MODÈLES SPONTANÉS DE DRH ANIMALES

La phototransduction



Principles and Practice of Clinical Electrophsyiology of Vision, 2nd Ed

LA PROMESSE DES MODÈLES ANIMAUX SPONTANÉS

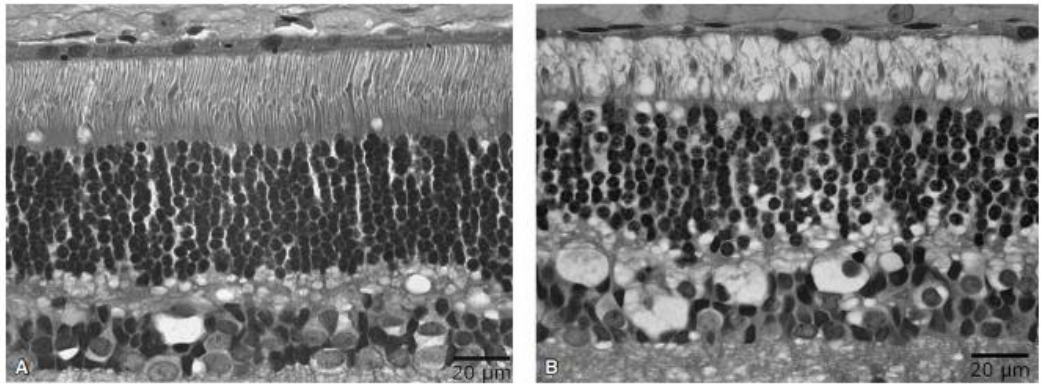
La phosphodiestérase

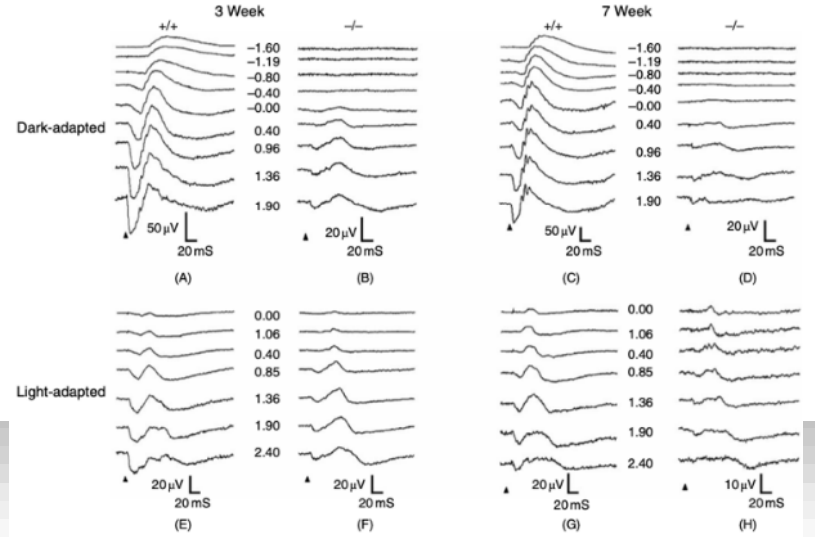
PDE6A : rcd3 - modèle RP43

cGMP Phosphodiesterase-α Mutation Causes Progress Retinal Atrophy in the Cardigan Welsh Corgi Dog

Simon M. Petersen-Jones,[1] David D. Entz, and David R. Sargan

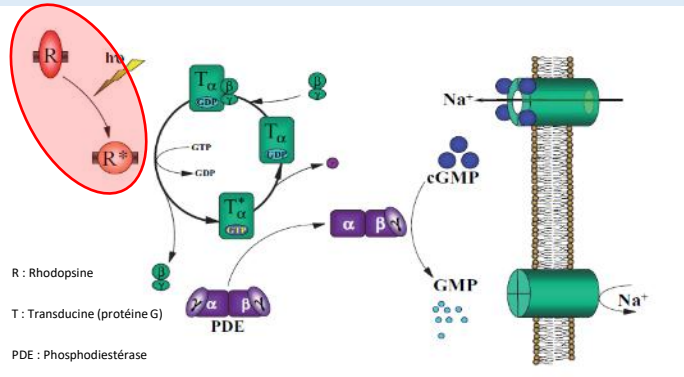
Investigative Ophthalmology & Visual Science, July 1999, Vol. 40, No. 8





LES MODÈLES SPONTANÉS DE DRH ANIMALES

La phototransduction



Principles and Practice of Clinical Electrophsyiology of Vision, 2nd Ed

La rhodopsine

RHO^{T4R} : APR dominante - modèle RP dominante

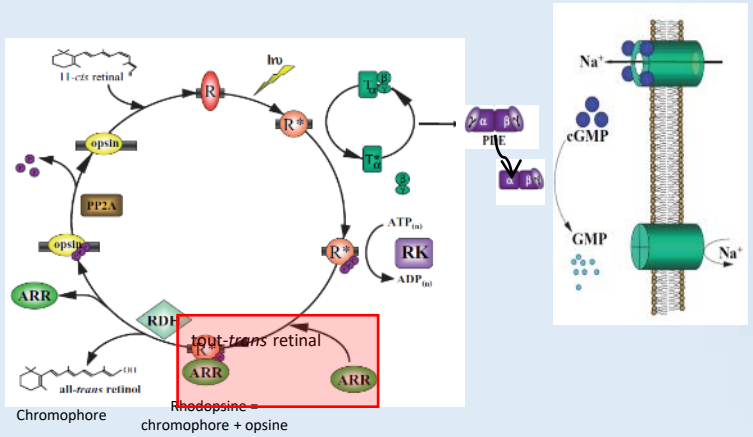
ARVO Annual Meeting Abstract | April 2014

Assessment of AAV-mediated RHO Augmentation in the Canine T4R RHO Model of Autosomal Dominant Retinitis Pigmentosa

Simone Iwabe; Sem Genini; Raghavi Sudharsan; Alfred S Lewin; Brian P Rossmiller; William W Hauswirth; Gustavo D Aguirre; William A Beltran

LES MODÈLES SPONTANÉS DE DRH ANIMALES

La phototransduction



Principles and Practice of Clinical Electrophsyiology of Vision, 2nd Ed

Les mécanismes de régulation - désactivation de la rhodopsine par l'arrestine (s-antigène)

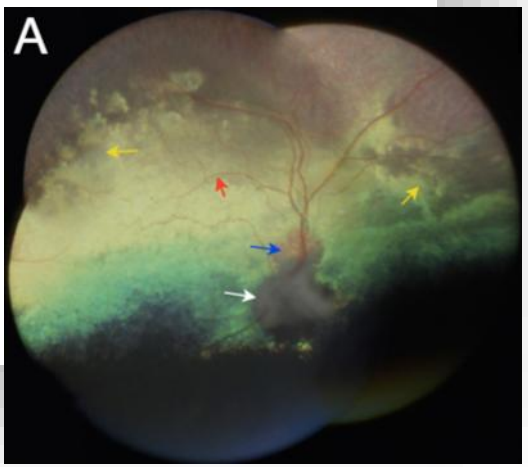
SAG : APR - modèle de la maladie d'OGUCHI et de divers RP associées

Molecular Vision 2013; 19:1871-1884 <http://www.molvis.org/molvis/v19/1871>
Received 7 June 2013 | Accepted 23 August 2013 | Published 27 August 2013

A non-stop S-antigen gene mutation is associated with late onset hereditary retinal degeneration in dogs

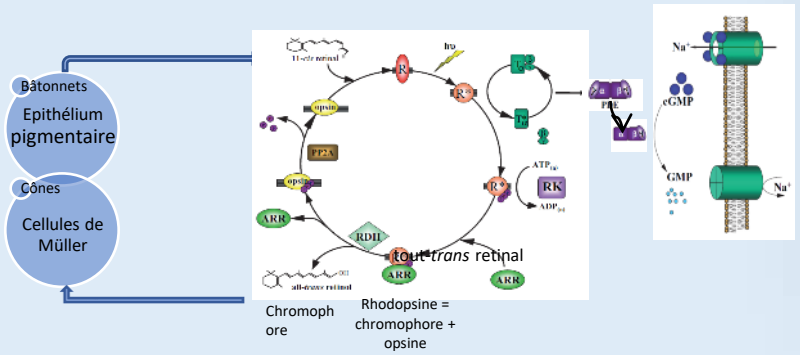
Orly Goldstein,[1] Julie Ann Jordan,[1] Gustavo D. Aguirre,[2] Gregory M. Acland[1]

[1]Baker Institute for Animal Health, Cornell University College of Veterinary Medicine, Ithaca, NY; [2]School of Veterinary Medicine, University of Pennsylvania, Philadelphia, PA



LES MODÈLES SPONTANÉS DE DRH ANIMALES

Le cycle visuel



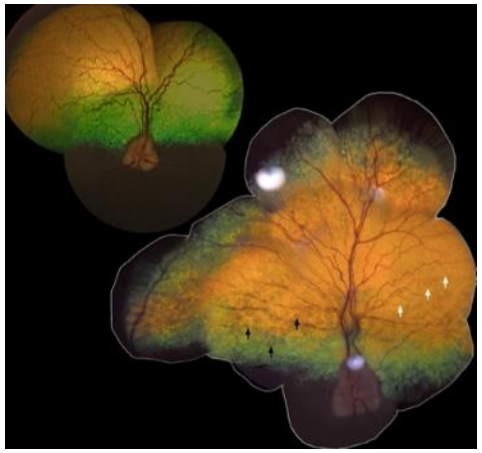
ABCA4 - modèle de la maladie de Stargardt

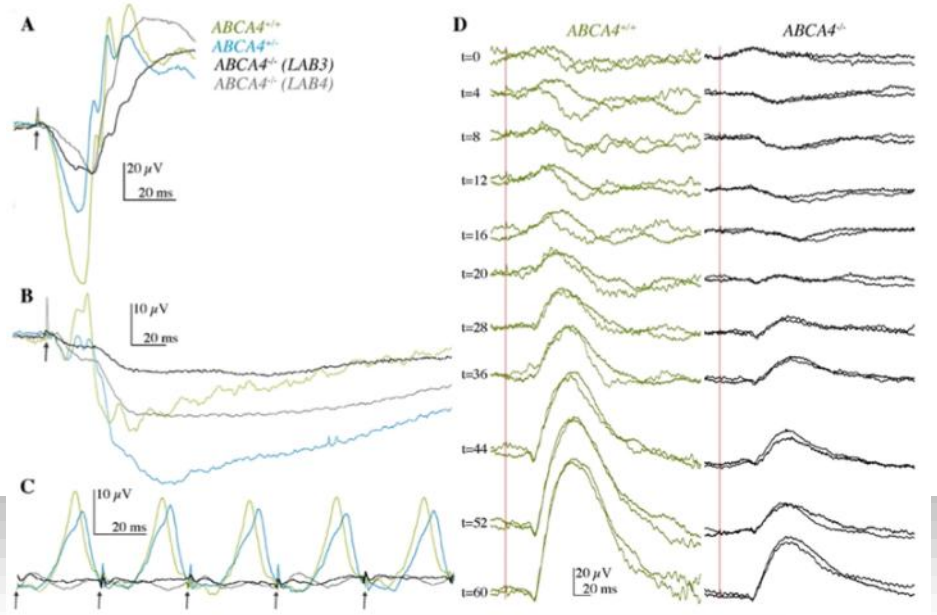
An *ABCA4* loss-of-function mutation causes a canine form of Stargardt disease

Suvi Mäkeläinen[1], Marta Gòdia[1¤], Minas Hellsand[2], Agnese Viluma[1], Daniela Hahn[1], Karim Makdoumi[3], Caroline J. Zeiss[4], Cathryn Mellersh[5], Sally L. Ricketts[5], Kristina Narfström[6], Finn Hallböök[2], Björn Ekesten[7], Göran Andersson[1], Tomas F. Bergström[1]*

1 Department of Animal Breeding and Genetics, Swedish University of Agricultural Sciences, Uppsala, Sweden, 2 Department of Neuroscience, Uppsala University, Uppsala, Sweden, 3 Department of Ophthalmology, Faculty of Medicine and Health, Örebro University, Örebro, Sweden, 4 Yale University School of Medicine, New Haven, Connecticut, United States of America, 5 Kennel Club Genetics Centre, Animal Health Trust, Lanwades Park, Kentford, Newmarket, Suffolk, United Kingdom, 6 Section for Comparative Ophthalmology, College of Veterinary Medicine, University of Missouri-Columbia, Missouri, United States of America, 7 Department of Clinical Sciences, Swedish University of Agricultural Sciences, Uppsala, Sweden

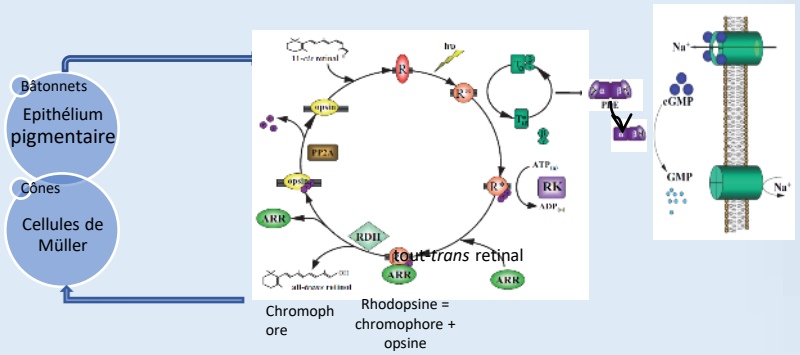
PLOS Genetics | https://doi.org/10.1371/journal.pgen.1007873 March 19, 2019





LES MODÈLES SPONTANÉS DE DRH ANIMALES

Le cycle visuel



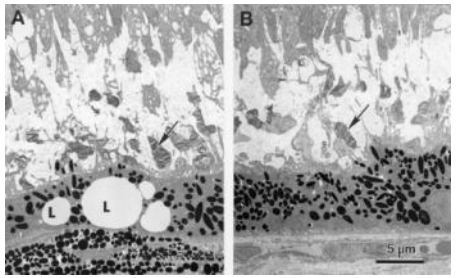
RPE65 - modèle de l'Amaurose Congénitale de Leber de type 2 (LCA2)

The Briard dog: a new animal model of congenital stationary night blindness

KRISTINA NARFSTRÖM, ANDERS WRIGSTAD, AND SVEN ERIK G NILSSON

From the Department of Ophthalmology, University of Linköping, S-581 85 Linköping, and Department of Surgery and Medicine, Faculty of Veterinary Medicine, Swedish University of Agricultural Sciences, S-750 07 Uppsala, Sweden

British Journal of Ophthalmology, 1989, **73**, 750–756



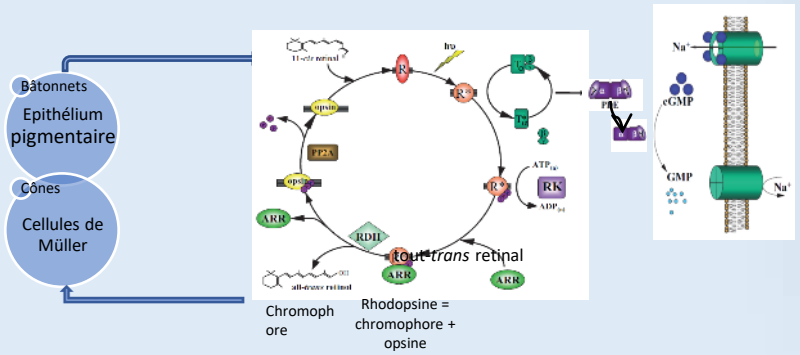
Gene therapy restores vision in a canine model of childhood blindness

Gregory M. Acland, Gustavo D. Aguirre, Jharna Ray, Qi Zhang, Tomas S. Aleman, Artur V. Cideciyan, Susan E. Pearce-Kelling, Vibha Anand, Yong Zeng, Albert M. Maguire, Samuel G. Jacobson, William W. Hauswirth & Jean Bennett

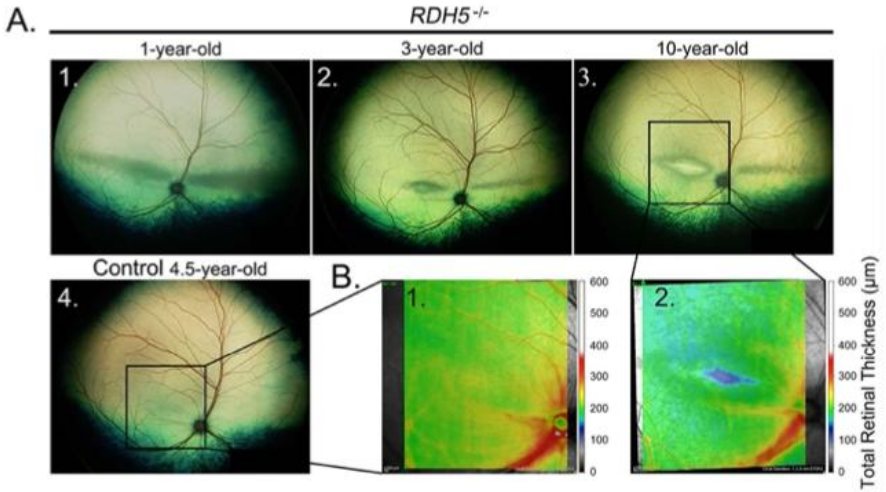
Nature Genetics **28**, 92–95 (2001)

LES MODÈLES SPONTANÉS DE DRH ANIMALES

Le cycle visuel



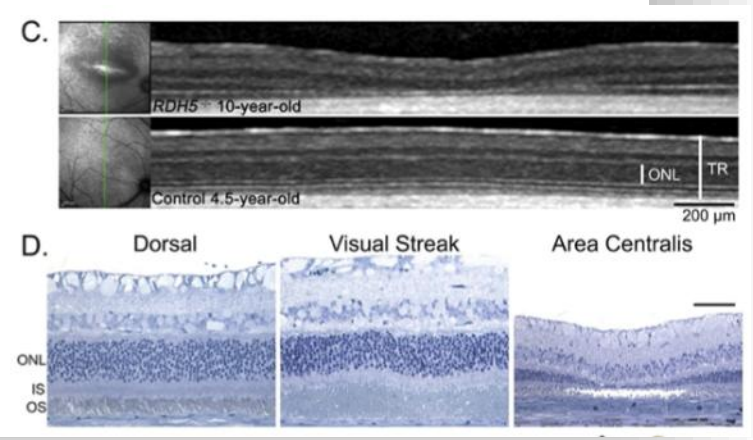
RDH5 - modèle d'atrophie maculaire



A large animal model of *RDH5*-associated retinopathy recapitulates important features of the human phenotype

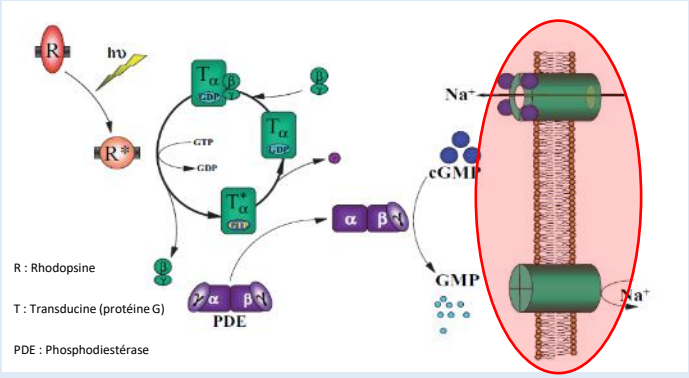
Laurence M. Occelli[1,†], Anahita Daruwalla[2,3,†], Samantha R. De Silva[4,5], Paige A. Winkler[1], Kelian Sun[1], Nathaniel Pasmanter[1], Andrea Minella[1], Janice Querubin[1], Leslie A. Lyons[6], 99 Lives Consortium[1], Anthony G. Robson[4,5], Elise Heon[7,8,9], Michel Michaelides[4,5], Andrew R. Webster[4,5], Krzysztof Palczewski[2,10,11], Ajoy Vincent[7,8,9], Omar A. Mahroo[4,5,12,13], Philip D. Kiser[2,10,14] and Simon M. Petersen-Jones[1,*]

Human Molecular Genetics, 2022, Vol. 31, 8, 1263–1277



LES MODÈLES SPONTANÉS DE DRH ANIMALES

Les canalopathies



Principles and Practice of Clinical Electrophsyiology of Vision, 2nd Ed

LA PROMESSE DES MODÈLES ANIMAUX SPONTANÉS

Les canaux CNG des bâtonnets

CNGA1 : APR - modèle RP49

CNGB1 : APR Type 1 - modèle RP45

A Large Animal Model for *CNGB1* Autosomal Recessive Retinitis Pigmentosa

Paige A. Winkler[1,2], Kari J. Ekenstedt[3], Laurence M. Occelli[1], Anton V. Frattaroli[4], Joshua T. Bartoe[1], Patrick J. Venta[1,2,5], Simon M. Petersen-Jones[1,2]*

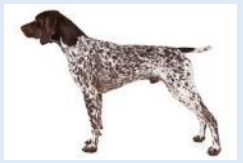
1 Department of Small Animal Clinical Sciences, College of Veterinary Medicine, Michigan State University, East Lansing, Michigan, United States of America, **2** Genetics Program, Michigan State University, East Lansing, Michigan, United States of America, **3** Department of Animal and Food Sciences, University of Wisconsin-River Falls, River Falls, Wisconsin, United States of America, **4** Health Information Technology, Michigan State University, East Lansing, Michigan, United States of America, **5** Department of Microbiology and Molecular Genetics, Michigan State University, East Lansing, Michigan, United States of America

Citation: Winkler PA, Ekenstedt KJ, Occelli LM, Frattaroli AV, Bartoe JT, et al. (2013) A Large Animal Model for *CNGB1* Autosomal Recessive Retinitis Pigmentosa. PLoS ONE 8(8): e72229. doi:10.1371/journal.pone.0072229

Molecular Therapy
Original Article

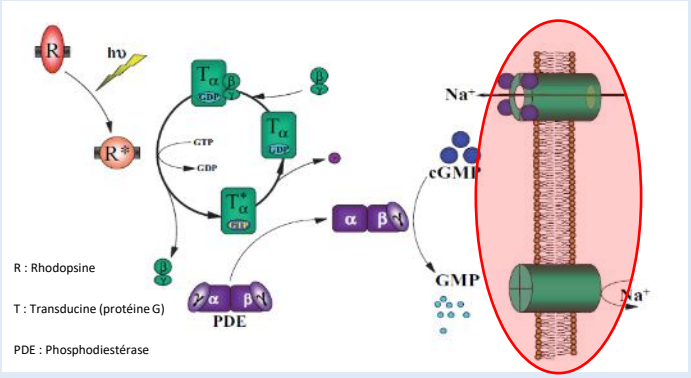
Development of a translatable gene augmentation therapy for *CNGB1*-retinitis pigmentosa

Laurence M. Occelli,[1] Lena Zobel,[2,3] Jonathan Stoddard,[4] Johanna Wagner,[2] Nathaniel Pasmanter,[1] Janice Querubin,[1] Lauren M. Renner,[4] Rene Reynaga,[4] Paige A. Winkler,[1] Kelian Sun,[1] Luis Felipe L.P. Marinho,[1] Catherine R. O'Riordan,[5] Amy Frederick,[5] Andreas Lauer,[6] Stephen H. Tsang,[7] William W. Hauswirth,[8] Trevor J. McGill,[4,6] Martha Neuringer,[4,6] Stylianos Michalakis,[2,3] and Simon M. Petersen-Jones[1]


LES MODÈLES SPONTANÉS DE DRH ANIMALES

Les canalopathies



Principles and Practice of Clinical Electrophsyiology of Vision, 2nd Ed

Les canaux CNG des cônes

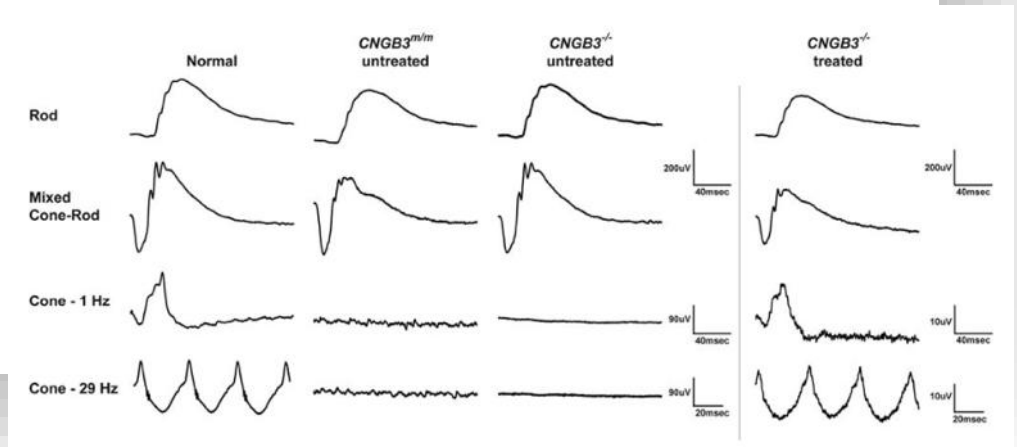
CNGA3, CNGB3 : achromatopsies canines - modèle achromatopsie

Gene therapy rescues cone function in congenital achromatopsia

András M. Komáromy[1,*], John J. Alexander[2,3,4], Jessica S. Rowlan[1], Monique M. Garcia[1,5], Vince A. Chiodo[3], Asli Kaya[5], Jacqueline C. Tanaka[5], Gregory M. Acland[6], William W. Hauswirth[2,3] and Gustavo D. Aguirre[1]

[1]Department of Clinical Studies, School of Veterinary Medicine, University of Pennsylvania, Philadelphia, PA 19104, USA, [2]Department of Molecular Genetics and Microbiology and [3]Department of Ophthalmology and Powell Gene Therapy Center, University of Florida, Gainesville, FL 32610, USA, [4]Vision Science Research Center, University of Alabama, Birmingham, AL 35294, USA, [5]Department of Biology, Temple University, Philadelphia, PA 19122, USA and [6]Baker Institute, Cornell University, Ithaca, NY 14853, USA

Human Molecular Genetics, 2010, Vol. 19, No. 13



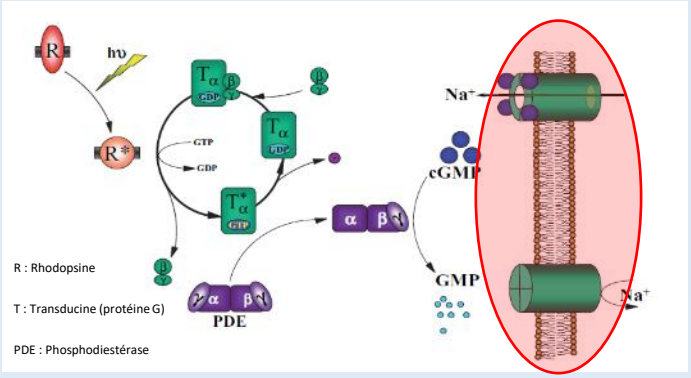
Safety and Efficacy Evaluation of rAAV2tYF-PR1.7-hCNGA3 Vector Delivered by Subretinal Injection in CNGA3 Mutant Achromatopsia Sheep

Elisha Gootwine, Ron Ofri, Eyal Banin, Alexey Obolensky, Edward Averbukh, Raaya Ezra-Elia, Maya Ross, Hen Honig, Alexander Rosov, Esther Yamin, Guo-jie Ye, David R. Knop, Paulette M. Robinson, Jeffrey D. Chulay, and Mark S. Shearman

Human Gene Therapy Clinical Development. Jun 2017. 96-107.
http://doi.org/10.1089/humc.2017.028

LES MODÈLES SPONTANÉS DE DRH ANIMALES

Les canalopathies



Principles and Practice of Clinical Electrophsyiology of Vision, 2nd Ed

Les canaux CNG des cônes

CNGA3 : achromatopsie ovine

Gene augmentation therapy cures novel day blindness in Local Awassi sheep

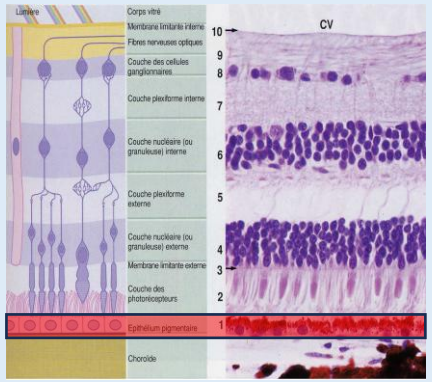
cmr1

cmr2

cmr3

LES MODÈLES SPONTANÉS DE DRH ANIMALES

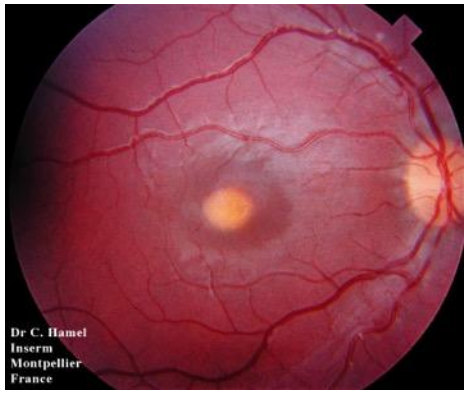
Les canalopathies

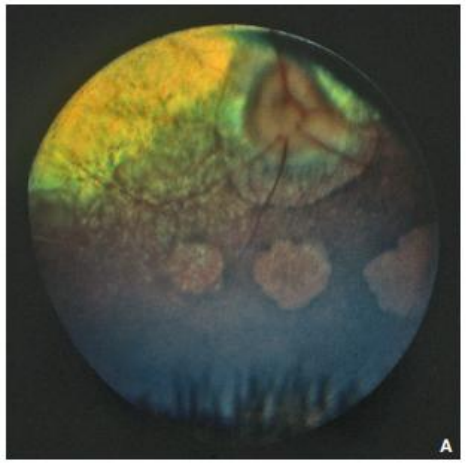


LA PROMESSE DES MODÈLES ANIMAUX SPONTANÉS

La Bestrophine : canal de l'EPR

BEST1 : cmr1, cmr2, cmr3 - modèle de la maladie de BEST de type 2





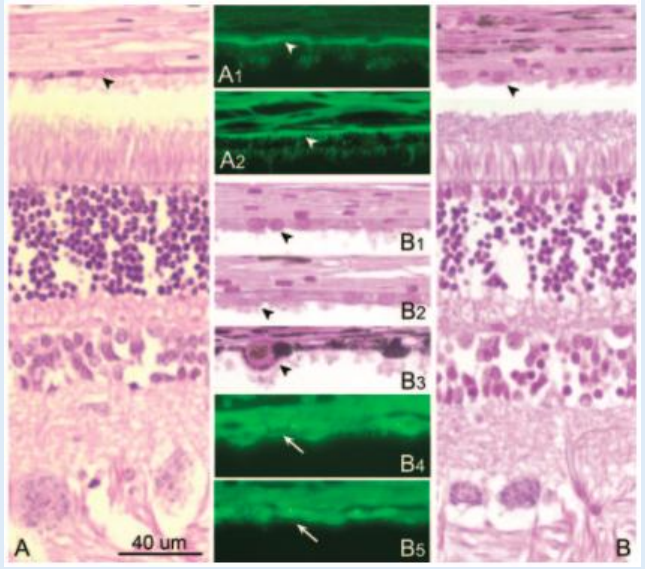
Bunel, Hum Gen 2019
Petersen-Jones, Vet Ophth, 2021

cmr1

cmr2

cmr3

LES MODÈLES SPONTANÉS DE DRH ANIMALES



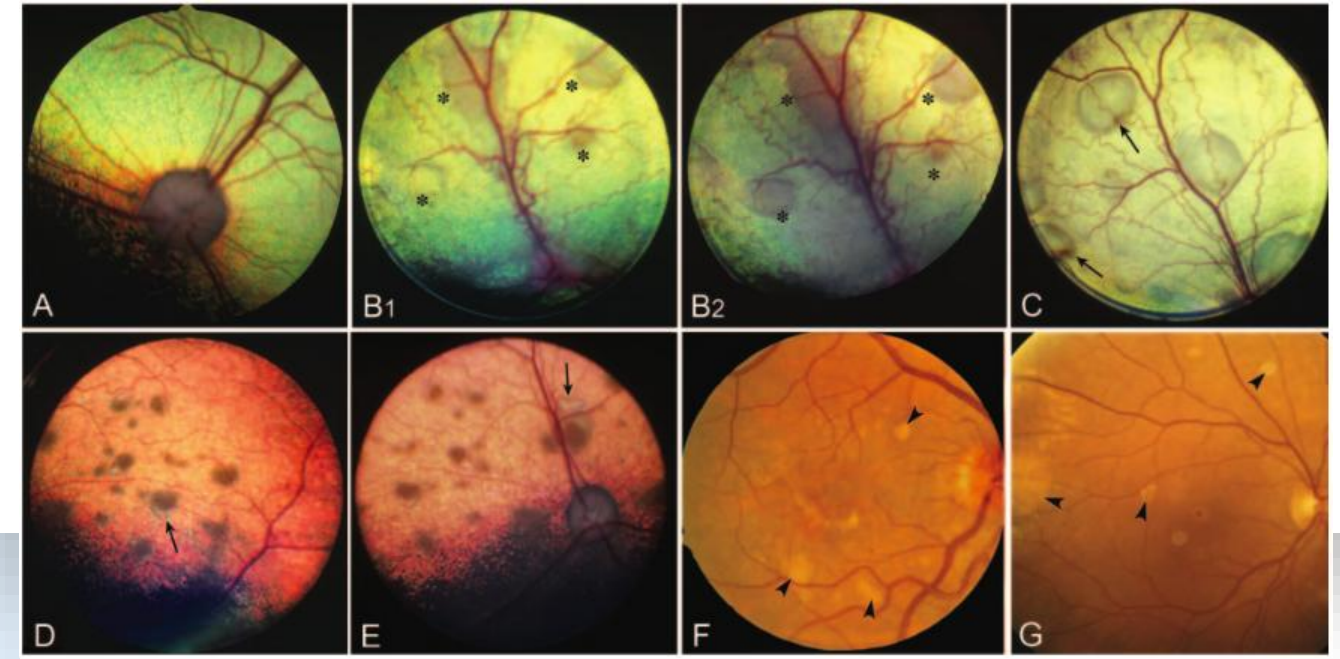
La Bestrophine : canal de l'EPR

BEST1 : cmr1, cmr2, cmr3 - modèle de la maladie de BEST de type 2

Bestrophin Gene Mutations Cause Canine Multifocal Retinopathy: A Novel Animal Model for Best Disease

Karina E. Guziewicz,[1] Barbara Zangerl,[1] Sarab J. Lindauer,[1] Robert F. Mullins,[2] Lynne S. Sandmeyer,[3] Bruce H. Grahn,[3] Edwin M. Stone,[2,4] Gregory M. Acland,[5] and Gustavo D. Aguirre[1]

IOVS, May 2007, Vol. 48, No. 5

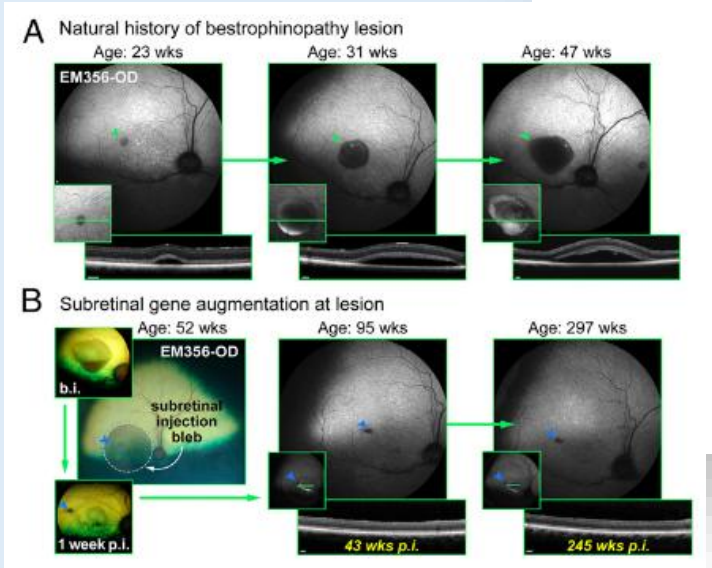


BEST1 gene therapy corrects a diffuse retina-wide microdetachment modulated by light exposure

Karina E. Guziewicz[a,1,2], Artur V. Cideciyan[b,1,2], William A. Beltran[a], András M. Komáromy[a,c], Valerie L. Dufour[a], Malgorzata Swider[b], Simone Iwabe[a], Alexander Sumaroka[b], Brian T. Kendrick[a], Gordon Ruthel[d], Vince A. Chiodo[e], Elise Héon[f], William W. Hauswirth[e], Samuel G. Jacobson[b], and Gustavo D. Aguirre[a]

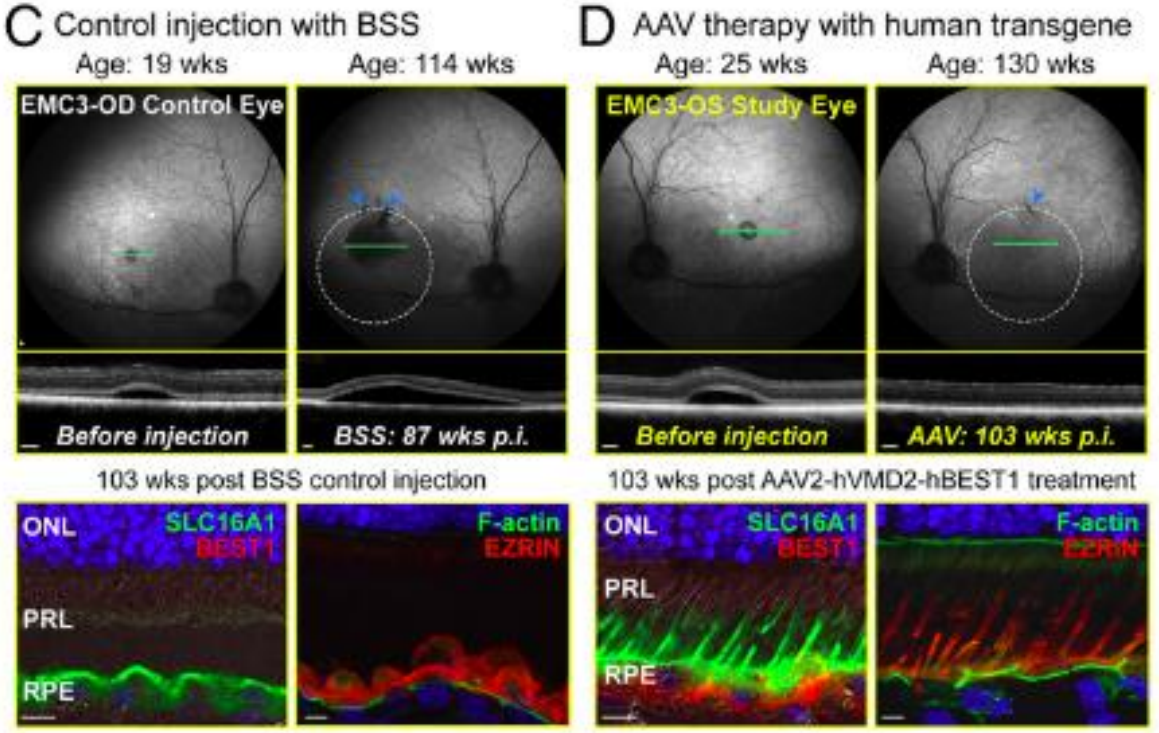
[a]Division of Experimental Retinal Therapies, Department of Clinical Sciences and Advanced Medicine, School of Veterinary Medicine, University of Pennsylvania, Philadelphia, PA 19104; [b]Scheie Eye Institute, Department of Ophthalmology, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA 19104; [c]Department of Small Animal Clinical Sciences, College of Veterinary Medicine, Michigan State University, East Lansing, MI 48824; [d]Department of Pathobiology, School of Veterinary Medicine, University of Pennsylvania, Philadelphia, PA 19104; [e]Department of Ophthalmology, College of Medicine, University of Florida, Gainesville, FL 32611; and [f]Department of Ophthalmology and Vision Sciences, The Hospital for Sick Children, University of Toronto, Toronto, ON M5G 2L3, Canada

LES MODÈLES SPONTANÉS DE DRH ANIMALES



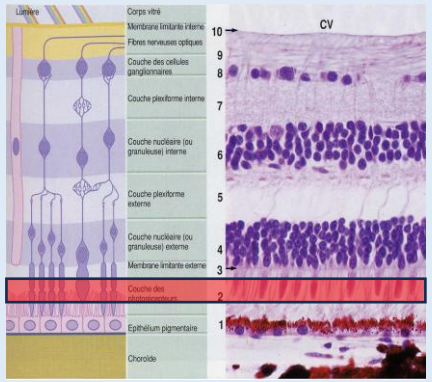
La Bestrophine : canal de l'EPR

BEST1 : cmr1, cmr2, cmr3 - modèle de la maladie de BEST de type 2



LES MODÈLES SPONTANÉS DE DRH ANIMALES

Les ciliopathies



CEP290 : rdAc - modèle de syndrome de Joubert / Amaurose Congénitale de Leber

Veterinary Ophthalmology (2018) **21**, 3, 224–232 DOI:10.1111/vop.12495

Central retinal preservation in *rdAc* cats

Andrea Louise Minella,* Laurence Mireille Occelli,* Kristina Narfström† and Simon Michael Petersen-Jones*

**Department of Small Animal Clinical Sciences, College of Veterinary Medicine, Michigan State University, East Lansing, MI, USA; and †Department of Medicine and Surgery, College of Veterinary Medicine, University of Missouri, Columbia, MO, USA*

Received: 13 July 2022 | Revised: 28 October 2022 | Accepted: 2 December 2022

DOI: 10.1111/vop.13052

ORIGINAL REPORT

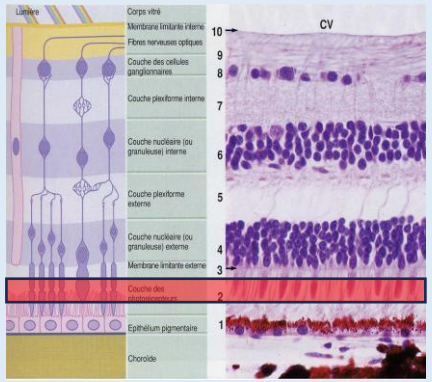
WILEY

Alternative splicing in *CEP290* mutant cats results in a milder phenotype than LCA^{CEP290} patients

Andrea L. Minella[1] | Kristina Narfström Wiechel[2] | Simon M. Petersen-Jones[1]

LES MODÈLES SPONTANÉS DE DRH ANIMALES

Les ciliopathies



LA PROMESSE DES MODÈLES ANIMAUX SPONTANÉS

- *BBS4* : APR - modèle de syndrome de Bardet-Biedl (type 4)

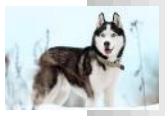
- *C2orf71* : Rcd4 - modèle de RP

- *CCDC66* : APR - modèle de RP

- *FAM161A* : APR de type 3 - modèle de RP

- *NPHP4* : crd - modèle de syndrome de Senior-Loken

- *IQCB1 / NPHP5* : crd2 - modèle de SLSN / LCA



- *RPGR* : xlpra1, xlpra2 - modèle de RP liées à l'X

- *RPGRIP1/MAP9* : crd - modèle de LCA

LES MODÈLES SPONTANÉS DE DRH ANIMALES

Le développement des PR

Le facteur de transcription CRX

CRX : crd - modèle de LCA de type 7

Crx^{Rdy} Cat: A Large Animal Model for *CRX*-Associated Leber Congenital Amaurosis

Laurence M. Occelli,[1] Nicholas M. Tran,[2] Kristina Narfström,[3] Shiming Chen,[2] and Simon M. Petersen-Jones[1]

[1]Small Animal Clinical Sciences, Michigan State University, East Lansing, Michigan, United States
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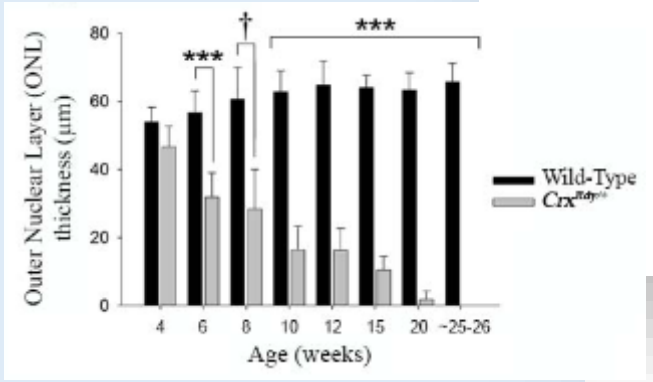
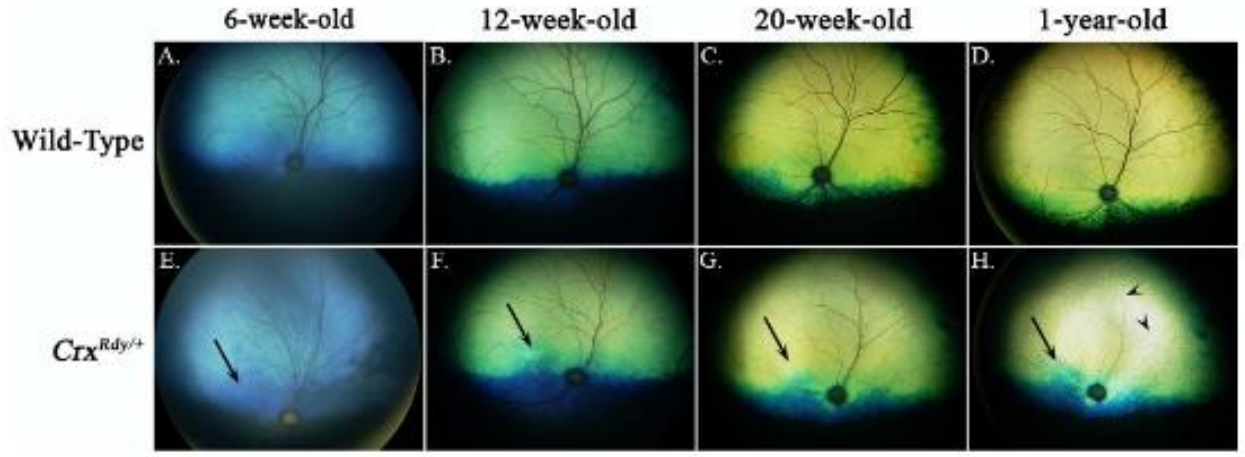


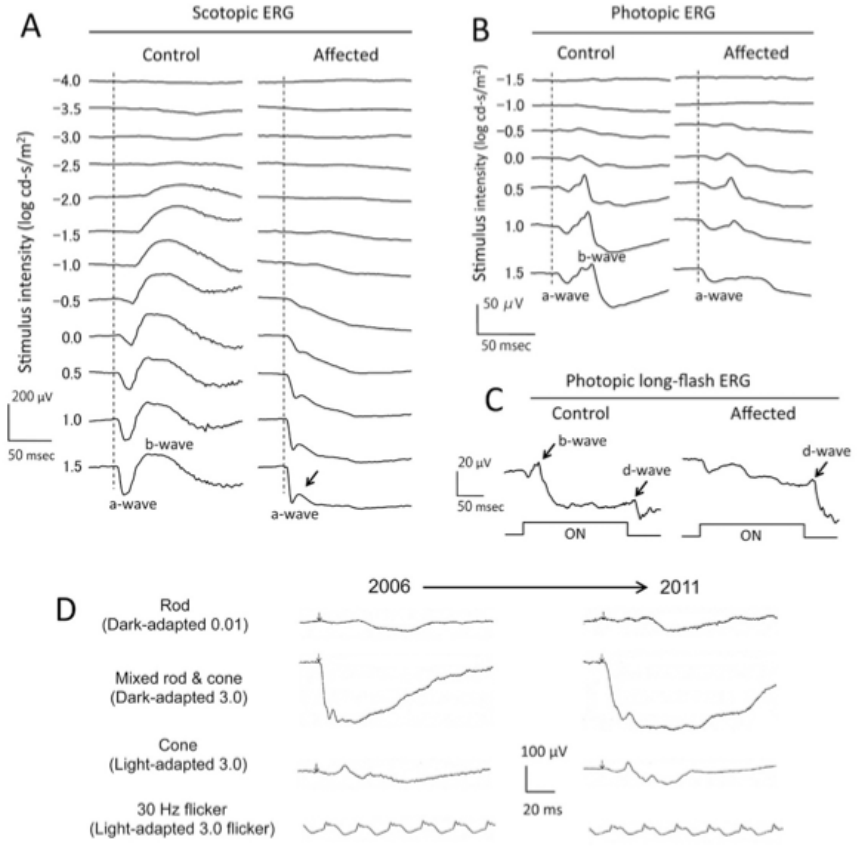




LES MODÈLES SPONTANÉS DE DRH ANIMALES

Les échanges synaptiques

LRIT3, TRPM1 - modèles de Cécité Nocturne Stationnaire Congénitale



A Naturally Occurring Canine Model of Autosomal Recessive Congenital Stationary Night Blindness

Mineo Kondo[1]*, Gautami Das[2], Ryoetsu Imai[3], Evelyn Santana[2], Tomio Nakashita[3], Miho Imawaka[3], Kosuke Ueda[3], Hirohiko Ohtsuka[3], Kazuhiko Sakai[4], Takehiro Aihara[4], Kumiko Kato[1], Masahiko Sugimoto[1], Shinji Ueno[5], Yuji Nishizawa[6], Gustavo D. Aguirre[2]*, Keiko Miyadera[2]

PLOS ONE | DOI:10.1371/journal.pone.0137072 September 14, 2015

LES MODÈLES SPONTANÉS DE DRH ANIMALES

Divers

- *ADAM9* : crd3 - modèle de RP

- *AIPL1* : rcd - modèle de LCA4

- *MERTK* : rcd - modèle de RP

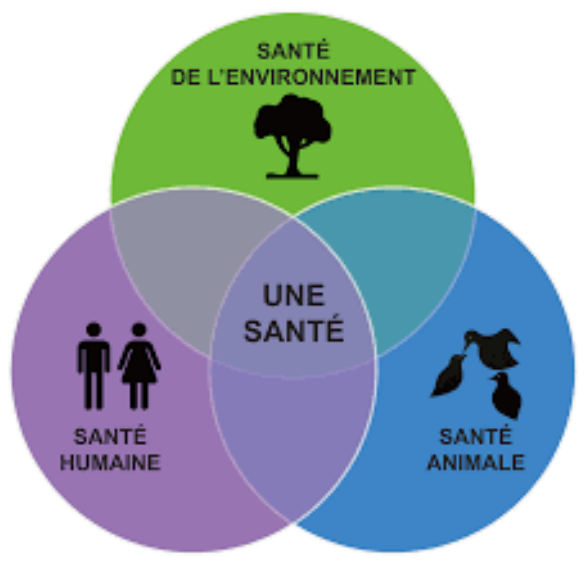
- *RD3* : rcd2 - modèle de LCA12

- *PRCD* : pra - modèle de RP

03

Les enjeux d'*une seule santé*

DES ENJEUX PARTAGÉS



- **HOMME**
  - ➢ Perspectives thérapeutiques (soin, guérison ?)
- **ANIMAL**
  - ➢ Éradication des DRH (sélection génétique)
    - ✓ *RPE65* < 0,0001%

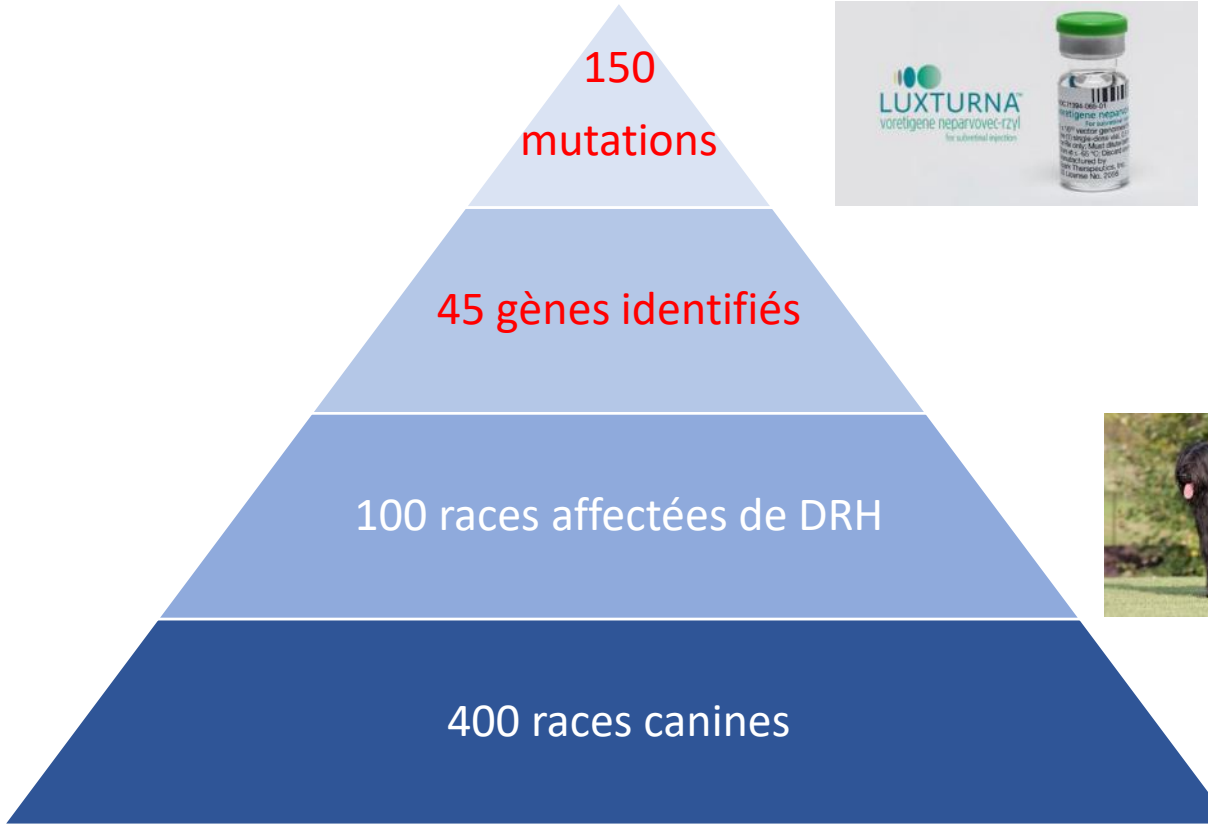
Bunel, Hum Gen 2019
Donner, PLoS Genet. 2023
Petersen-Jones, Vet Ophth, 2021

LES ENJEUX VÉTÉRINAIRES

ASSOCIATION FRENCH EYE PANELISTS/
MALADIES HEREDITAIRES OCULAIRES DES CARNIVORES

- **VÉTÉRINAIRE**
  - ➢ Expertise :
    - ✓ Diagnostic des sujets malades
    - ✓ Dépistage des reproducteurs
  - ➢ Conseil :
    - ✓ Club de races (stratégie)
    - ✓ Éleveurs (reproduction)

DES PERSPECTIVES PROMETTEUSES



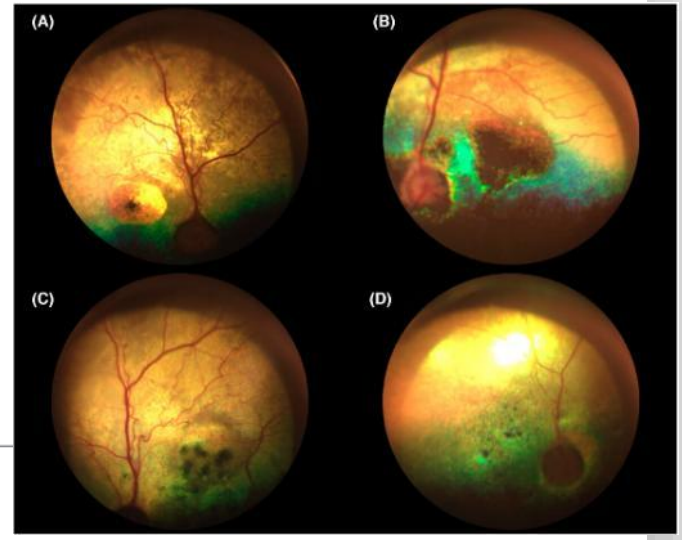
UNE VEILLE DE TERRAIN ACTIVE

ANIMAL GENETICS
Molecular Genetics and Genomics

Whole genome sequencing identifies a homozygous nonsense mutation in the *JPH2* gene in Shih Tzu dogs with progressive retinal atrophy

G. Urkasemsin, M. Pongpanich, L. Sariya, A. Kongcharoen, R. Buddhirongawatr, S. Rungarunlert, J. N. Ferreira, W. Chetruengchai, C. Phokaew, C. Srichomthong, V. Shotelersuk

First published: 06 July 2021 | https://doi.org/10.1111/age.13118 | Citations: 5



Received: 5 February 2023 | Revised: 3 September 2023 | Accepted: 6 October 2023
DOI: 10.1111/vop.13153

ORIGINAL REPORT

Retinopathy in Greyhound dogs: Prevalence, fundoscopic, and histopathological findings

Petra S. A. Price[1] | Hayley Hunt[2] | Neil R. Cox[3] | Nadia L. Mitchell[4] | Arthur C. Irving[5]

WILEY

Received: 9 June 2023 | Revised: 11 September 2023 | Accepted: 19 September 2023
DOI: 10.1111/vop.13151

ORIGINAL REPORT

Additional evidence supports *GRM6* p.Thr178Met as a cause of congenital stationary night blindness in three horse breeds

Elizabeth Esdaile[1] | Kelly E. Knickelbein[2] | Callum G. Donnelly[2,3] | Michelle Ferneding[4] | Monica J. Motta[4] | Brett D. Story[4] | Felipe Avila[1] | Carrie J. Finno[3] | Brian C. Gilger[5,6] | Lynne Sandmeyer[7] | Sara Thomasy[4,8] | Rebecca R. Bellone[1,3]

Received: 7 June 2022 | Revised: 13 February 2023 | Accepted: 14 February 2023
DOI: 10.1111/vop.13079

ORIGINAL REPORT

WILEY

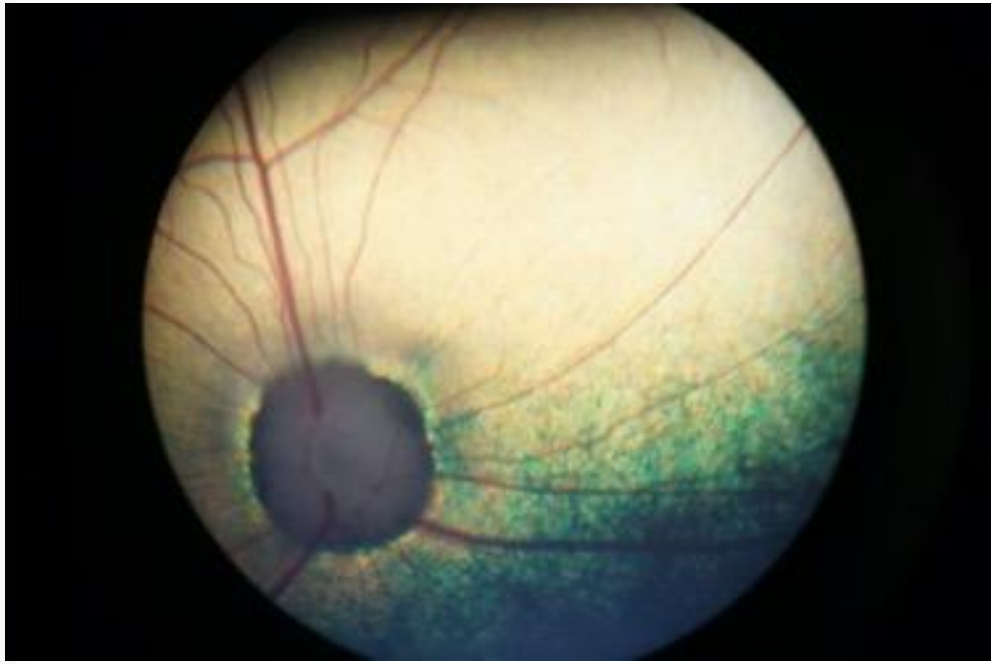
Preliminary characterization of a novel form of progressive retinal atrophy in the German Spitz dog associated with a frameshift mutation in *GUCY2D*

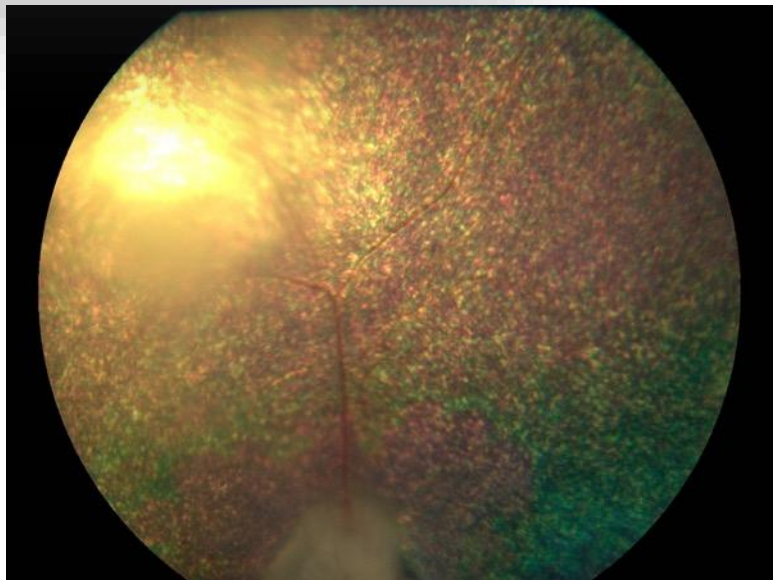
Mariza Bortolini[1] | Paige A. Winkler[2] | Juan Carlos Duque Moreno[1] | Mario Teruo Sato[3] | Bianca Luiza Valduga Guareschi[1] | Simon M. Petersen-Jones[2] | Fabiano Montiani-Ferreira[1]

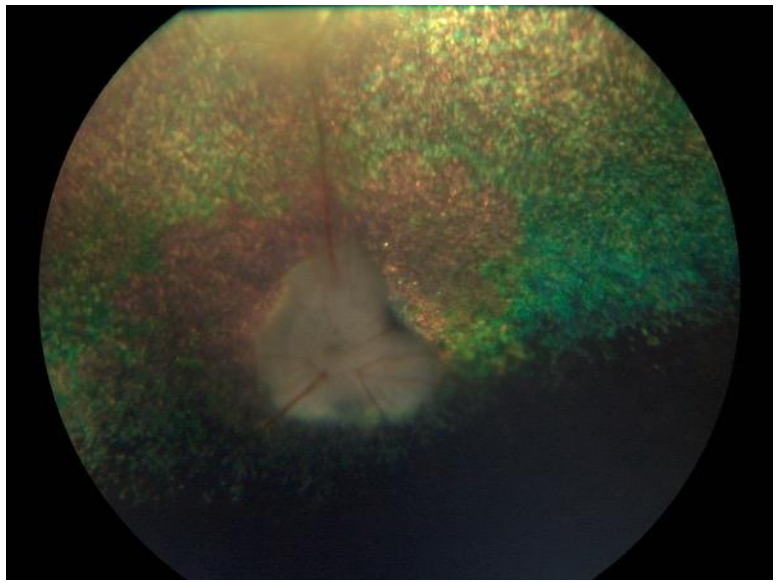
DRH : enjeux cliniques et génétiques

Les progrès de la génétique permettent aujourd'hui d'identifier et de mieux comprendre les **dystrophies rétiniennes héréditaires animales**, facilitant leur **éradication** par la mise en œuvre d'une **sélection génétique** raisonnée.

Ces modèles animaux ouvrent des perspectives prometteuses à la recherche en **thérapie génique appliquée aux DRH humaines**, dont la majorité reste incurable à ce jour.







AFOV

Association pour la Formation en Ophtalmologie Vétérinaire

VPLUS

RÉSEAU VÉTÉRINAIRE

MERCI

DE VOTRE ATTENTION

Conflits d'intérêt : Aucun

Déclaration sur l'usage de l'intelligence artificielle : L'auteur n'a pas utilize de logiciel d'intelligence artificielle pour générer tout ou partie de cette présentation

RÉFÉRENCES

- Acland GM, Aguirre GD, Bennett J, Aleman TS, Cideciyan AV, Bennicelli J, Dejneka NS, Pearce-Kelling SE, Maguire AM, Palczewski K, Hauswirth WW, Jacobson SG. Long-term restoration of rod and cone vision by single dose rAAV-mediated gene transfer to the retina in a canine model of childhood blindness. Mol Ther. 2005 Dec;12(6):1072-82. doi: 10.1016/j.ymthe.2005.08.008. Epub 2005 Oct 14. PMID: 16226919; PMCID: PMC3647373.
- Bellone RR, Brooks SA, Sandmeyer L, Murphy BA, Forsyth G, Archer S, Bailey E, Grahn B. Differential gene expression of TRPM1, the potential cause of congenital stationary night blindness and coat spotting patterns (LP) in the Appaloosa horse (Equus caballus). Genetics. 2008 Aug;179(4):1861-70. doi: 10.1534/genetics.108.088807. Epub 2008 Jul 27. PMID: 18660533; PMCID: PMC2516064.
- Beltran WA, Cideciyan AV, Guziewicz KE, Iwabe S, Swider M, Scott EM, Savina SV, Ruthel G, Stefano F, Zhang L, Zorger R, Sumaroka A, Jacobson SG, Aguirre GD. Canine retina has a primate fovea-like bouquet of cone photoreceptors which is affected by inherited macular degenerations. PLoS One. 2014 Mar 5;9(3):e90390. doi: 10.1371/journal.pone.0090390. PMID: 24599007; PMCID: PMC3944008.
- Berta ÁI, Boesze-Battaglia K, Genini S, Goldstein O, O'Brien PJ, Szél Á, Acland GM, Beltran WA, Aguirre GD. Photoreceptor cell death, proliferation and formation of hybrid rod/S-cone photoreceptors in the degenerating STK38L mutant retina. PLoS One. 2011;6(9):e24074. doi: 10.1371/journal.pone.0024074. Epub 2011 Sep 30. PMID: 21980341; PMCID: PMC3184085.
- Bunel M, Chaudieu G, Hamel C, et al. Natural models for retinitis pigmentosa: progressive retinal atrophy in dog breeds. Hum Genet. 2019;138:441-453.
- Donner J, Freyer J, Davison S, et al. Genetic prevalence and clinical relevance of canine mendelian disease variants in over one million dogs. PLoS Genet. 2023;19:e1010651.
- Goldstein O, Jordan JA, Aguirre GD, Acland GM. A non-stop S-antigen gene mutation is associated with late onset hereditary retinal degeneration in dogs. Mol Vis. 2013 Aug 27;19:1871-84. PMID: 24019744; PMCID: PMC3762564.
- Gootwine, E.; Ofri, R.; Banin, E.; Obolensky, A.; Averbukh, E.; Ezra-Elia, R.; Ross, M.; Honig, H.; Rosov, A.; Yamin, E.; et al. Safety and E cacy Evaluation of rAAV2tYF-PR1.7-hCNGA3 Vector Delivered by Subretinal Injection in CNGA3 Mutant Achromatopsia Sheep. Hum. Gene Ther. Clin. Dev. 2017, 28, 96–107.
- Grozdanic SD, Lazic T, Kecova H, Mohan K, Kuehn MH. Optical coherence tomography and molecular analysis of sudden acquired retinal degeneration syndrome (SARDS) eyes suggests the immune-mediated nature of retinal damage. Vet Ophthalmol. 2019 May;22(3):305-327. doi: 10.1111/vop.12597. Epub 2018 Aug 15. PMID: 30109754; PMCID: PMC6563498.
- Grozdanic SD, Lazic T, Kecova H, Mohan K, Adamus G, Kuehn MH. Presumed cancer-associated retinopathy (CAR) mimicking Sudden Acquired Retinal Degeneration Syndrome (SARDS) in canines. Vet Ophthalmol. 2021 Mar;24(2):125-155. doi: 10.1111/vop.12853. Epub 2020 Dec 27. PMID: 33369040; PMCID: PMC8048582.

RÉFÉRENCES

- Guziewicz, K.E.; Zangerl, B.; Lindauer, S.J.; Mullins, R.F.; Sandmeyer, L.S.; Grahn, B.H.; Stone, E.M.; Acland, G.M.; Aguirre, G.D. Bestrophin gene mutations cause canine multifocal retinopathy: A novel animal model for best disease. Investig. Opthalmol. Vis. Sci. 2007, 48, 1959–1967.
- Guziewicz, K.E.; Cideciyan, A.V.; Beltran, W.A.; Komaromy, A.M.; Dufour, V.L.; Swider, M.; Iwabe, S.; Sumaroka, A.; Kendrick, B.T.; Ruthel, G.; et al. BEST1 gene therapy corrects a diffuse retina-wide microdetachment modulated by light exposure. Proc. Natl. Acad. Sci. USA 2018, 115, E2839–E2848.
- Hamel CP. Les dystrophies rétiniennes héréditaires : apports de la génétique moléculaire. Biologie Aujourd'hui. 2013, 207 (2), 73-85.
- Kijas JW, Cideciyan AV, Aleman TS, et al. Naturally occurring rhodopsin mutation in the dog causes retinal dysfunction and degeneration mimicking human dominant retinitis pigmentosa. Proc Natl Acad Sci USA 2002;99: 6328–6333.
- Komáromy AM, Alexander JJ, Rowlan JS, Garcia MM, Chiodo VA, Kaya A, Tanaka JC, Acland GM, Hauswirth WW, Aguirre GD. Gene therapy rescues cone function in congenital achromatopsia. Hum Mol Genet. 2010 Jul 1;19(13):2581-93. doi: 10.1093/hmg/ddq136. Epub 2010 Apr 8. Erratum in: Hum Mol Genet. 2011 Dec 15;20(24):5024. PMID: 20378608; PMCID: PMC2883338.
- Kondo M, Das G, Imai R, Santana E, Nakashita T, Imawaka M, Ueda K, Ohtsuka H, Sakai K, Aihara T, Kato K, Sugimoto M, Ueno S, Nishizawa Y, Aguirre GD, Miyadera K. A Naturally Occurring Canine Model of Autosomal Recessive Congenital Stationary Night Blindness. PLoS One. 2015 Sep 14;10(9):e0137072. doi: 10.1371/journal.pone.0137072. PMID: 26368928; PMCID: PMC4569341.
- Kostic C, Arsenijevic Y. Animal modelling for inherited central vision loss. J Pathol. 2016 Jan;238(2):300-10. doi: 10.1002/path.4641. Epub 2015 Nov 13. PMID: 26387748; PMCID: PMC5063185.
- Magnusson H. Über retinitis pigmentosa und Konsanguinität beim hunde. Arch Vergleichende Ophthal. 1911;2:147–163.
- Mäkeläinen S, Gòdia M, Hellsand M, Viluma A, Hahn D, Makdoumi K, Zeiss CJ, Mellersh C, Ricketts SL, Narfström K, Hallböök F, Ekesten B, Andersson G, Bergström TF. An ABCA4 loss-of-function mutation causes a canine form of Stargardt disease. PLoS Genet. 2019 Mar 19;15(3):e1007873. doi: 10.1371/journal.pgen.1007873. PMID: 30889179; PMCID: PMC6424408.
- Minella AL, Occelli LM, Narfström K, Petersen-Jones SM. Central retinal preservation in rdAc cats. Vet Ophthalmol. 2018 May;21(3):224-232. doi: 10.1111/vop.12495. Epub 2017 Aug 30. PMID: 28856832.
- Minella AL, NarfströmWiechel K, Petersen-Jones SM. Alternative splicingin CEP290 mutant cats results in a milderphenotype than LCACEP290 patients. VetOphthalmol. 2023;26:4-11. doi:10.1111/vop.13052
- Mowat FM, Iwabe S, Aguirre GD, Petersen-Jones SM. Consensus guidelines for nomenclature of companion animal inherited retinal disorders. Vet Ophthalmol. 2024;00:1-5. doi:10.1111/vop.13185.
- Narfstrom K, Wrigstad A, Nilsson SE. The briard dog: a new animal model of congenital stationary night blind- ness. Br J Ophthalmol 1989;73:750–756.
- Occelli LM, Tran NM, Narfström K, Chen S, Petersen-Jones SM. CrxRdy Cat: A Large Animal Model for CRX-Associated Leber Congenital Amaurosis. Invest Ophthalmol Vis Sci. 2016 Jul 1;57(8):3780-92. doi: 10.1167/iovs.16-19444. PMID: 27427859; PMCID: PMC4960999.

RÉFÉRENCES

- Occelli LM, Daruwalla A, De Silva SR, Winkler PA, Sun K, Pasmanter N, Minella A, Querubin J, Lyons LA; 99 Lives Consortium; Robson AG, Heon E, Michaelides M, Webster AR, Palczewski K, Vincent A, Mahroo OA, Kiser PD, Petersen-Jones SM. A large animal model of RDH5-associated retinopathy recapitulates important features of the human phenotype. Hum Mol Genet. 2022 Apr 22;31(8):1263-1277. doi: 10.1093/hmg/ddab316. PMID: 34726233; PMCID: PMC9029234.
- Occelli LM, Zobel L, Stoddard J, Wagner J, Pasmanter N, Querubin J, Renner LM, Reynaga R, Winkler PA, Sun K, Marinho LFLP, O'Riordan CR, Frederick A, Lauer A, Tsang SH, Hauswirth WW, McGill TJ, Neuringer M, Michalakis S, Petersen-Jones SM. Development of a translatable gene augmentation therapy for CNGB1-retinitis pigmentosa. Mol Ther. 2023 Jul 5;31(7):2028-2041. doi: 10.1016/j.ymthe.2023.04.005. Epub 2023 Apr 13. PMID: 37056049; PMCID: PMC10362398.
- Petersen-Jones SM, Mowat FM. Diseases of the Canine Ocular Fundus. In Veterinary Ophthalmology: Volume II, Sixth Edition. Edited by Kirk N. Gelatt, Gil Ben-Shlomo, Brian C. Gilger, Diane V.H. Hendrix, Thomas J. Kern, and Caryn E. Plummer. P 1477-1574.
- Petersen-Jones SM, Komáromy AM. Dog models for blinding inherited retinal dystrophies. Hum Gene Ther Clin Dev. 2015 Mar;26(1):15-26. doi: 10.1089/humc.2014.155. Epub 2015 Feb 11. PMID: 25671556; PMCID: PMC4442585.
- Petersen-Jones SM, Entz DD, Sargan DR. cGMP phos- phodiesterase-a mutation causes progressive retinal atro- phy in the Cardigan Welsh corgi dog. Invest Ophthalmol Vis Sci 1999;40:1637–1644.
- Petit L, Lheriteau E, Weber M, et al. Restoration of vision in the pde6beta-deficient dog, a large animal model of rod–cone dystrophy. Mol Ther 2012;20:2019–2030.
- Simone Iwabe, Sem Genini, Raghavi Sudharsan, Alfred S Lewin, Brian P Rossmiller, William W Hauswirth, Gustavo D Aguirre, William A Beltran; Assessment of AAV-mediated RHO Augmentation in the Canine T4R RHO Model of Autosomal Dominant Retinitis Pigmentosa. *Invest. Ophthalmol. Vis. Sci.* 2014;55(13):3316.
- Somma AT, Moreno JCD, Sato MT, Rodrigues BD, Bacellar-Galdino M, Occelli LM, Petersen-Jones SM, Montiani-Ferreira F. Characterization of a novel form of progressive retinal atrophy in Whippet dogs: a clinical, electroretinographic, and breeding study. Vet Ophthalmol. 2017 Sep;20(5):450-459. doi: 10.1111/vop.12448. Epub 2016 Nov 29. PMID: 27896899.
- Suber ML, Pittler SJ, Qin N, Wright GC, Holcombe V, Lee RH, Craft CM, Lolley RN, Baehr W, Hurwitz RL. Irish setter dogs affected with rod/cone dysplasia contain a nonsense mutation in the rod cGMP phosphodiesterase beta-subunit gene. Proc Natl Acad Sci U S A. 1993 May 1;90(9):3968-72. doi: 10.1073/pnas.90.9.3968. PMID: 8387203; PMCID: PMC46427.
- Winkler PA, Occelli LM, Petersen-Jones SM. Large Animal Models of Inherited Retinal Degenerations: A Review. Cells. 2020 Apr 3;9(4):882. doi: 10.3390/cells9040882. PMID: 32260251; PMCID: PMC7226744.
- www.retnet.org