

Nouveautés dans le diagnostic et la prise en charge des maladies rénales



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28 Nov 2024
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Objectifs:

- Connaître l'épidémiologie et la définition des MRC
- Comment accompagner les patients:
 - mythes
 - prise en charge multidisciplinaire
- Connaître les bases du traitement de MRC
- Future traitements

American Kidney Fund®
FIGHTING ON ALL FRONTS

5 Myths & Facts ABOUT KIDNEY DISEASE

Myth: Kidney disease is not a serious condition.
Fact: Kidney disease is 1 of the top 10 causes of death in the U.S.

Kidney disease is the fastest-growing chronic condition in the U.S. 37 million Americans have kidney disease, and 1 in 3 is at risk for the disease.

Myth: There's nothing you can do about getting kidney disease.
Fact: Most cases of kidney disease could be prevented.

Though some rare conditions can damage your kidneys, diabetes and high blood pressure cause 3 out of every 4 new cases of kidney failure. Keeping those conditions under control could help you prevent kidney disease.

Myth: You'd know it if you had kidney disease.
Fact: Kidney disease often has no symptoms until the late stages.





Chronic kidney disease damages your kidneys slowly over time—9 out of 10 people with early kidney disease don't know it. It can be detected through simple blood and urine tests. Ask your doctor!

Myth: A kidney transplant is a cure for kidney failure.
Fact: There is no cure for kidney failure.

If you have kidney failure (end-stage renal disease, or ESRD), you will need either dialysis or a transplant to live. A kidney transplant is usually considered the best treatment but kidney failure, but it is not a cure.

Myth: Kidney stones cause kidney disease.
Fact: Kidney stones rarely cause permanent kidney damage.

1 in 10 people will have a kidney stone, yet the great majority will never develop kidney disease. Kidney stones are rarely left untreated because they are so painful. Help prevent kidney stones by drinking plenty of water every day!

Join the conversation and connect with us!    

KidneyFund.org
1-800-638-8299

Monsieur M, 65 ans

- AC: HTA depuis 15 ans, tt amlodipine 10mg/j
- Check up:
 - Créatinine 200 $\mu\text{mol/l}$, K 4.7 mmol/l, chol 4.0 mmol/l, LDL 2.8 mmol/l
 - Débit de Filtration Glomérulaire 29 ml/min/1.73m²
 - ACR 25mg/mmol, sédiment: Hb- L-.
- Diagnostic?
- Que faites vous?

Définition MRC:

- La présence d'anomalies **structurelles** ou **fonctionnelles** rénales pendant **au moins trois mois**

- **En pratique:**

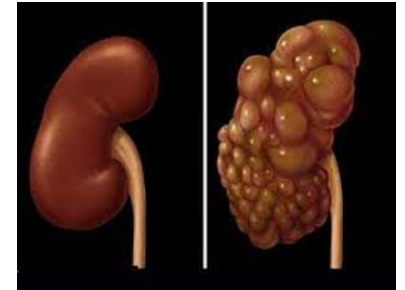
-Débit de filtration glomérulaire (DFG ou eGFR) $<60\text{ml/min/1.73m}^2$

-et/ou albuminurie $>30\text{mg/j}$ (ou $\geq 3\text{mg/mmol}$)

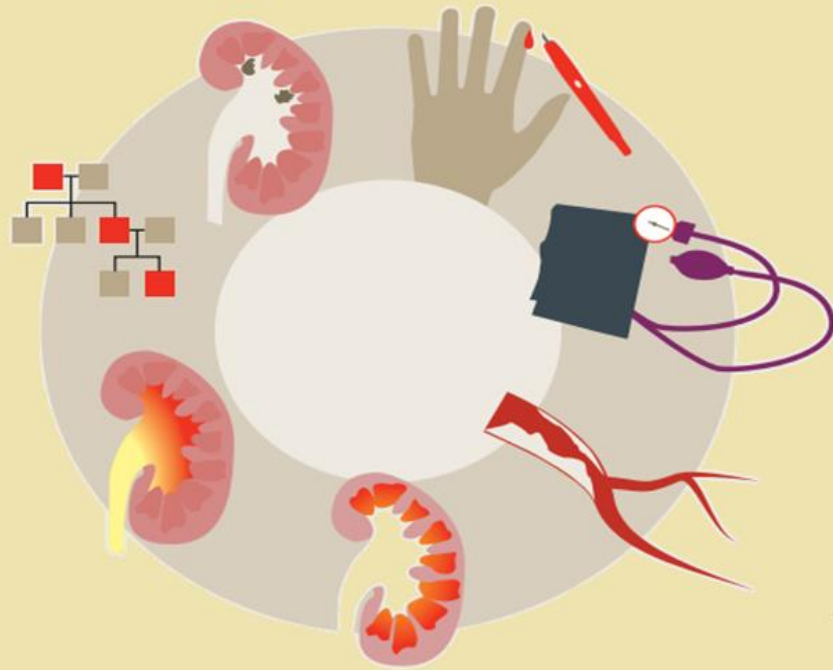
-pendant au moins 3 mois

- Notre patient: DFG: 29 ml/min/1.73m^2 ACR 25mg/mmol , sédiment: Hb-

- Diagnostic: Maladie rénale chronique



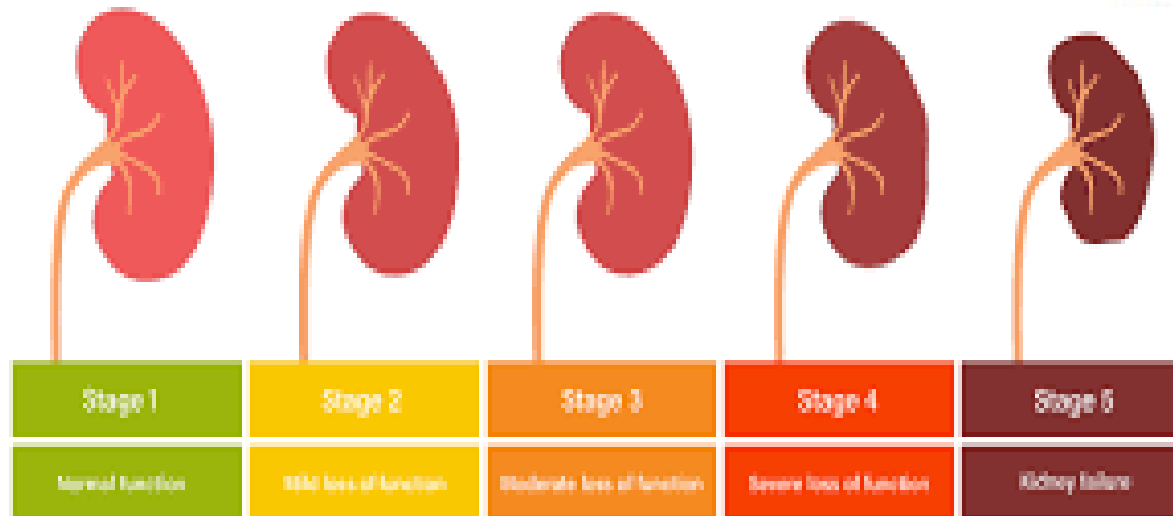
Etiologie MRC



- DM
- HTA
- Vieillessement
- Maladies lithiasiques
- Néphrite Interstitielle-Glomérulonéphrites
- Pyélonéphrites-Infections
- Maladies rénales génétiques

Stades de MRC

STAGES OF CHRONIC KIDNEY DISEASE



DFG

≥ 90

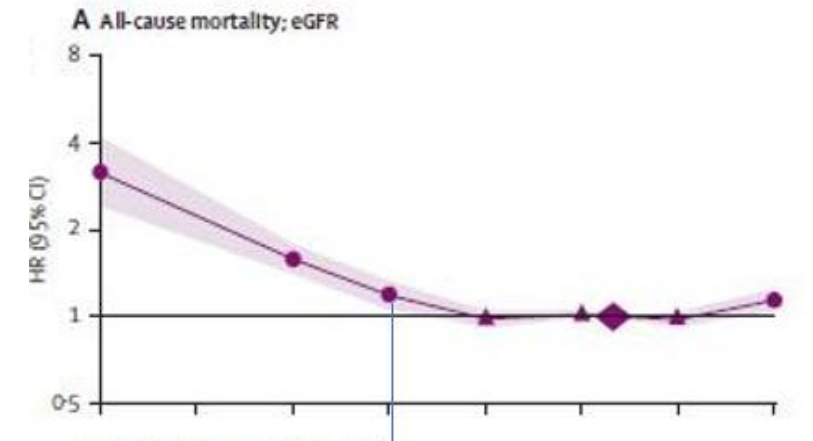
60-89

30-60

15-29

< 15

DFG=60



Classification KDIGO et albuminurie

Notre patient: MRC G4A2

l'IRC

est classée en fonction de:

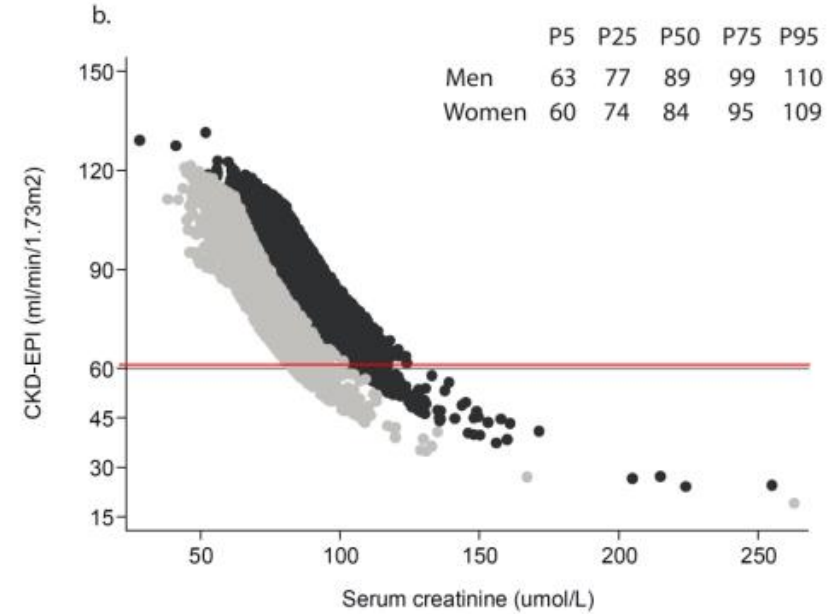
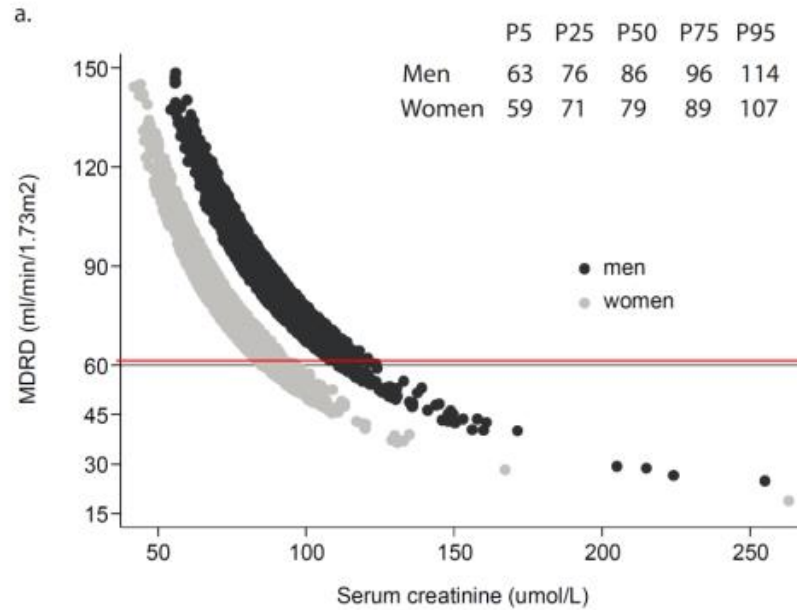
- Cause (C)
- DFGe (G)
- Albuminurie (A)

- Risque faible
(peut refléter une IRC si d'autres marqueurs d'insuffisance rénale sont présents; sinon pas d'IRC)
- Risque modérément accru
- Risque modéré à fortement accru
- Risque élevé
- Risque très élevé

				Catégories Albuminurie Description et intervalles		
				A1	A2	A3
				Normale à modérément augmentée	Modérément augmentée	augmentée
				<30mg/g <3 mg/mmol	30-300mg/g 3-30mg/mmol	>300mg/g >30mg/mmol
Catégories de DFGe (ml/min/1.73m ²) Description et valeur	G1	Normal ou hyperfiltration	≥90	1 si IRC	Traiter 1	Référer 2
	G2	Diminution légère	60-89	1 si IRC	Traiter 1	Référer 2
	G3a	Diminution légère à modérée	45-59	Traiter 1	Traiter 2	Référer 3
	G3b	Diminution modérée à sévère	30-44	Traiter 2	Traiter 3	Référer 3
	G4	Sévèrement diminué	15-29	Référer 3	Référer 3	Référer 4+
	G5	Insuffisance rénale terminale	≤15	Référer 4+	Référer 4+	Référer 4+

G5D si dialyse

Prévalence IRC à Lausanne: étude CoLaus



Prévalence : ~10%

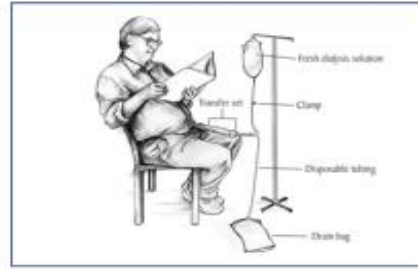
Stages	MDRD	CKD-Epi
1	2.1%	2.3%
2	3.5%	3.2%
3	4.7%	4.5%
4-5	0.17%	0.17%
TOTAL	10.4%	10.2%
3-5	4.87%	4.67%

Prévalence IRC et IRT (insuffisance rénale terminale) en Suisse:

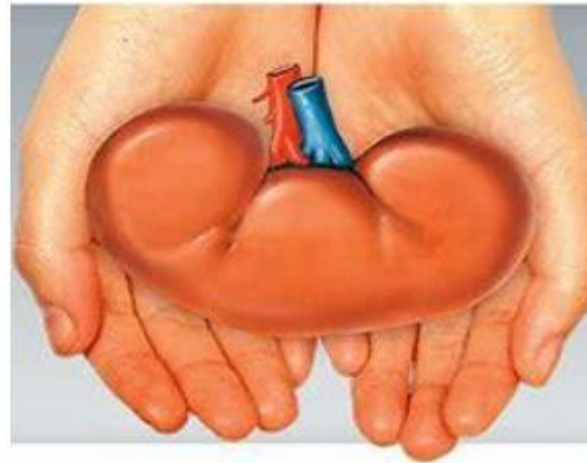
IRC=10%=850'000 personnes



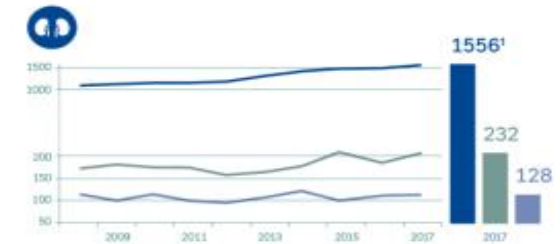
~ 4500 personnes
hémodialysés



~500 patients en dialyse
péritonéale



Nierentransplantationen und Warteliste | 2017

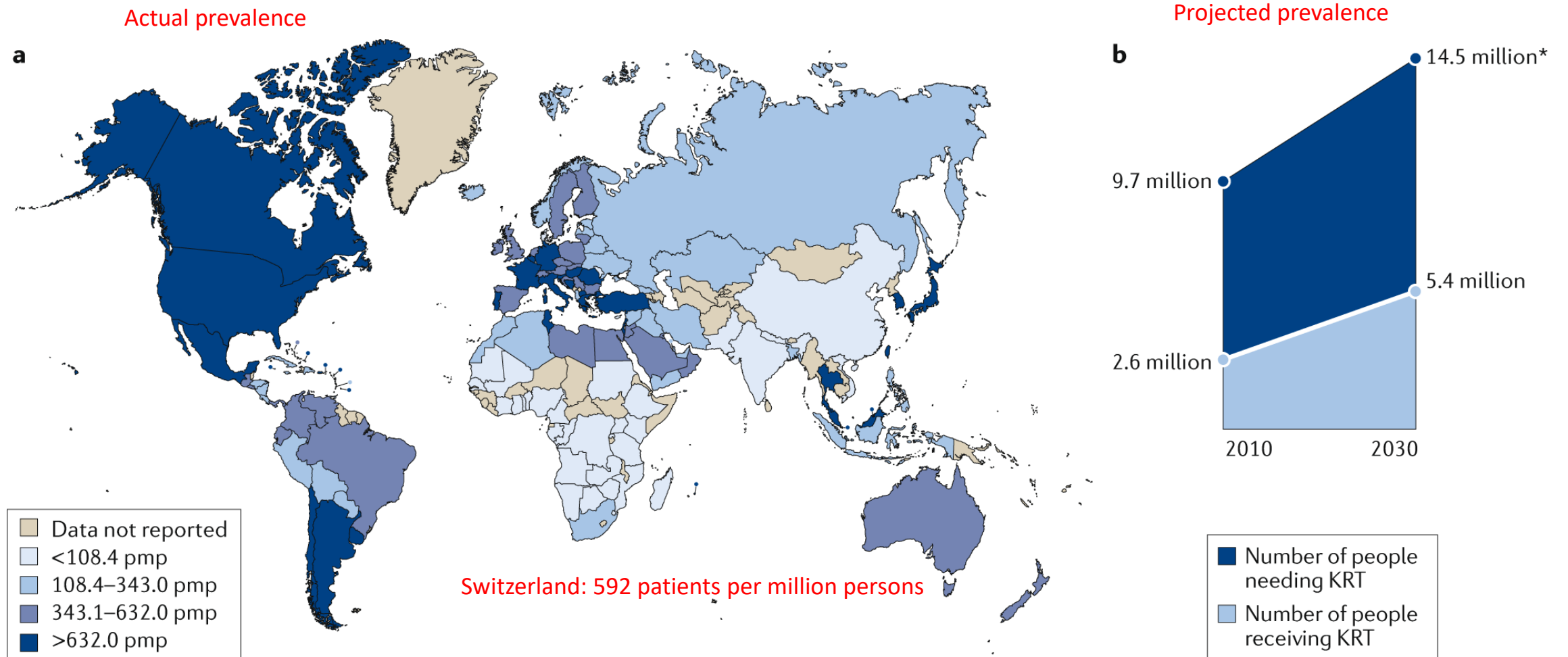


350
NT/année

~4500 patients transplantés

www.svk.org;
www.swisstransplant.org

Nombre de patients avec RRT



Mythes et réalités des MRC: «il faut boire beaucoup»



- European Food Safety Authority Guidelines: 2.5l pour hommes, 2l pour les femmes.
- National Kidney Foundation: 3l pour hommes, 2.2l pour les femmes.
- Tiktok:

- Evidence?



- *EFSA Panel on Dietetic Products, Nutrition, and Allergies. Scientific opinion on dietary reference values for water. EFSA J 2010; 8: 1459*

Effect of Coaching to Increase Water Intake on Kidney Function Decline in Adults With Chronic Kidney Disease

The CKD WIT Randomized Clinical Trial

William F. Clark, MD; Jessica M. Sontrop, PhD; Shih-Han Huang, MD, PhD; Kerri Gallo, RN; Louise Moist, MD, MSc; Andrew A. House, MD; Meaghan S. Cuerden, MSc; Matthew A. Weir, MD, MSc; Amit Bagga, MD; Scott Brimble, MD; Andrew Burke, MD; Norman Muirhead, MD; Sanjay Pandeya, MD; Amit X. Garg, MD, PhD

RESULTS Of 631 randomized patients (mean age, 65.0 years; men, 63.4%; mean eGFR, 43 mL/min/1.73 m²; median urine albumin, 123 mg/d), 12 died (hydration group [n = 5]; control group [n = 7]). Among 590 survivors with 1-year follow-up measurements (95% of 619), the mean change in 24-hour urine volume was 0.6 L per day higher in the hydration group (95% CI, 0.5 to 0.7; $P < .001$). The mean change in eGFR was -2.2 mL/min/1.73 m² in the hydration group and -1.9 mL/min/1.73 m² in the control group (adjusted between-group difference, -0.3 mL/min/1.73 m² [95% CI, -1.8 to 1.2; $P = .74$]). The mean between-group differences (hydration vs control) in secondary outcomes were as follows: plasma copeptin, -2.2 pmol/L (95% CI, -3.9 to -0.5; $P = .01$); creatinine clearance, 3.6 mL/min/1.73 m² (95% CI, 0.8 to 6.4; $P = .01$); urine albumin, 7 mg per day (95% CI, -4 to 51; $P = .11$); and quality of health, 0.2 points (95% CI, -0.3 to 0.3; $P = .22$).

CONCLUSIONS AND RELEVANCE Among adults with chronic kidney disease, coaching to increase water intake compared with coaching to maintain the same water intake did not significantly slow the decline in kidney function after 1 year. However, the study may have been underpowered to detect a clinically important difference.

TRIAL REGISTRATION clinicaltrials.gov Identifier: [NCT01766687](https://clinicaltrials.gov/ct2/show/study/NCT01766687).

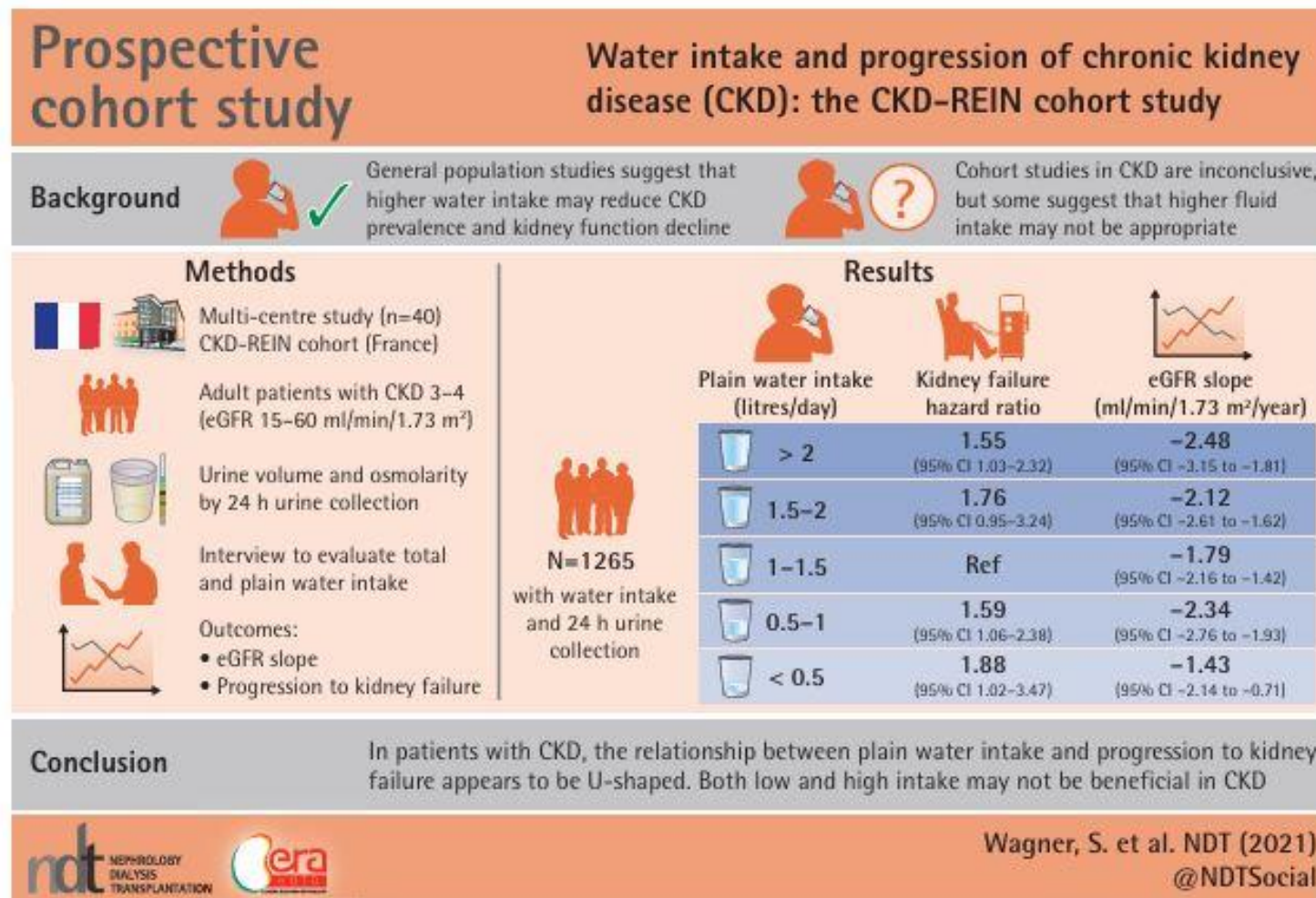
- IRC stade G3 (eGFR 30-60 ml/min/1.73m²)
- Coaching pour boire plus d'eau vs normale
- Suivi 12 mois Delta eGFR



eGFR, mL/min per 1.73 m ²	Mean (95% CI)		Adjusted Between-Group Difference in Change ^b (95% CI)	P Value
	Hydration Group (n = 311)	Control Group (n = 308)		
Prerandomization	43.3 (42.1 to 44.4)	43.6 (42.6 to 44.7)		
12 Months	41.0 (39.5 to 42.6)	41.7 (40.3 to 43.1)		
Change	-2.2 (-3.3 to -1.1) ^c	-1.9 (-2.9 to -0.9) ^c	-0.3 (-1.8 to 1.2)	.74

Water intake and progression of chronic kidney disease: the CKD-REIN cohort study

Sandra Wagner¹, Thomas Merkling¹, Marie Metzger², Lise Bankir³, Maurice Laville⁴, Luc Frimat^{5,6}, Christian Combe^{7,8}, Christian Jacquelinet^{2,9}, Denis Fouque⁴, Ziad A. Massy^{2,10} and Bénédict Stengel²; for the CKD-REIN study group*



N=1265, 3y follow up

Si MRC: boire 1-1.5l/jour



Un expert rappelle les bonnes pratiques

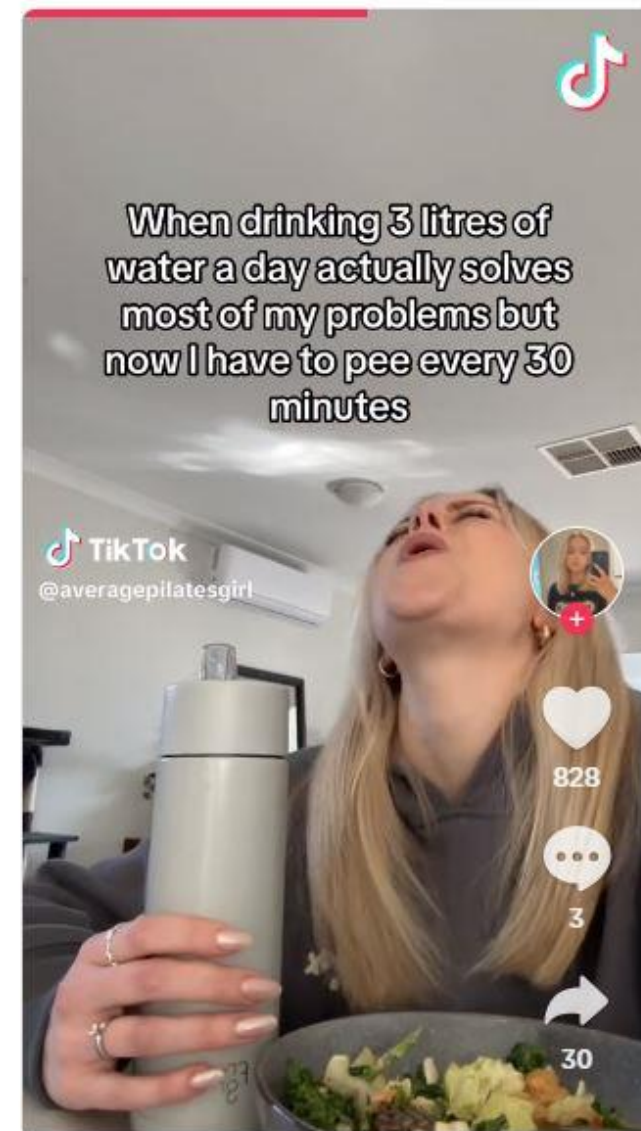
Quelle quantité d'eau faut-il vraiment boire chaque jour?

Les gourdes XXL défilent sur TikTok, où de nombreux influenceurs conseillent de boire de grandes quantités d'eau. Cette habitude est-elle vraiment bénéfique? Un spécialiste démêle le vrai du faux.

Publié: 19.02.2024 à 19:00 heures | Dernière mise à jour: 20.02.2024 à 09:49 heures

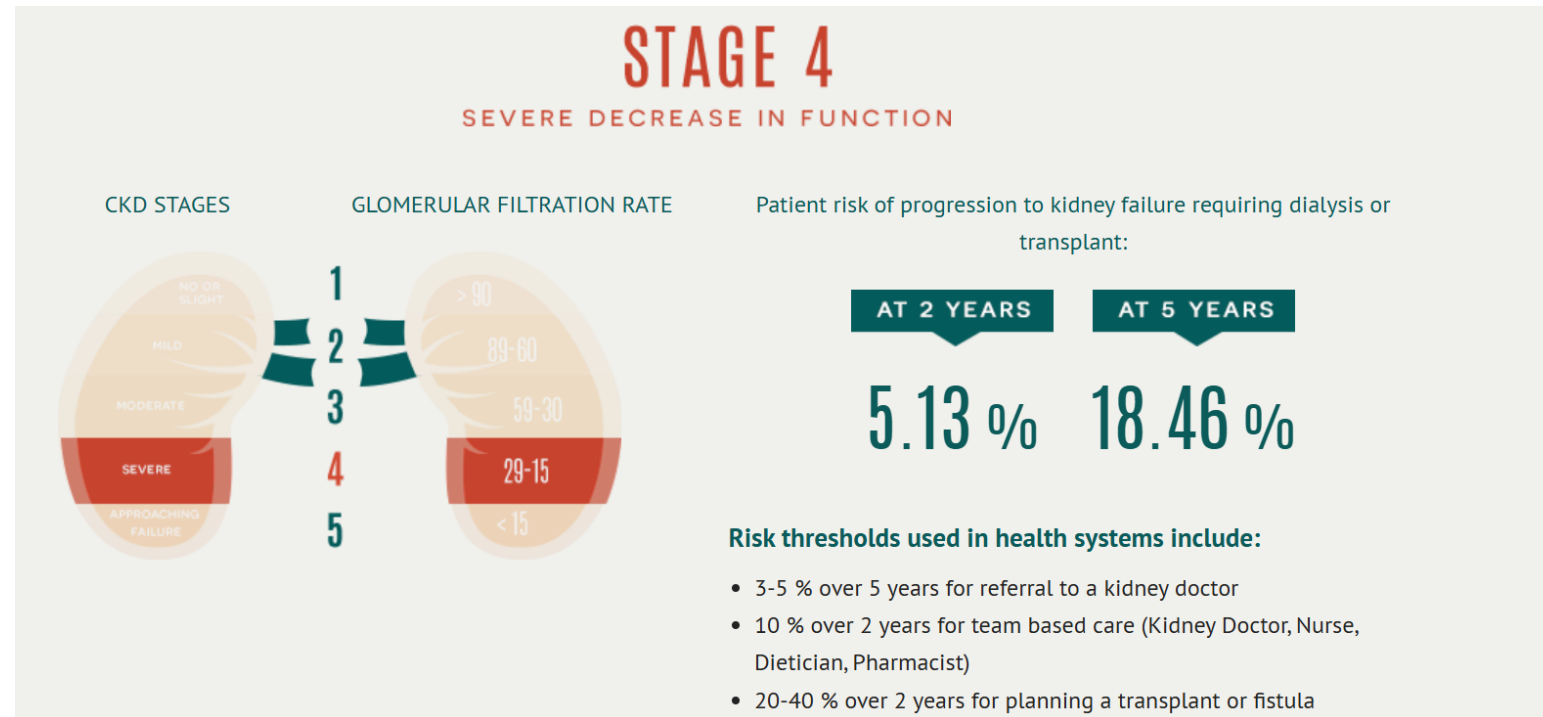
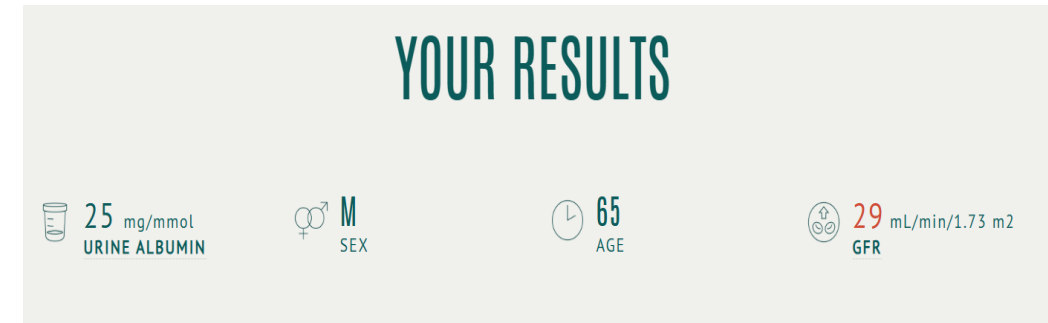
Que se passe-t-il quand on boit davantage?

Le professeur Pruijm indique par ailleurs que plusieurs études basées sur des échantillons d'urine ont pu démontrer que nous atteignons ces taux sans problème: «En Europe, on boit probablement plus que nécessaire pour survivre, constate-t-il. Nos besoins dépendent du sexe, de l'âge, du taux d'activité physique et du climat. En général, le corps humain est capable de nous signaler un manque d'eau via la sensation de soif.»



Mythe 2: MRC= certain d'avoir besoin de dialyse

- Kidney Failure Risk Equation (KFRE) prédit risque de progression CKD 3b-5
- Inclut âge, sexe, eGFR, albuminurie¹
<https://kidneyfailurerisk.com/>
- Notre patient:

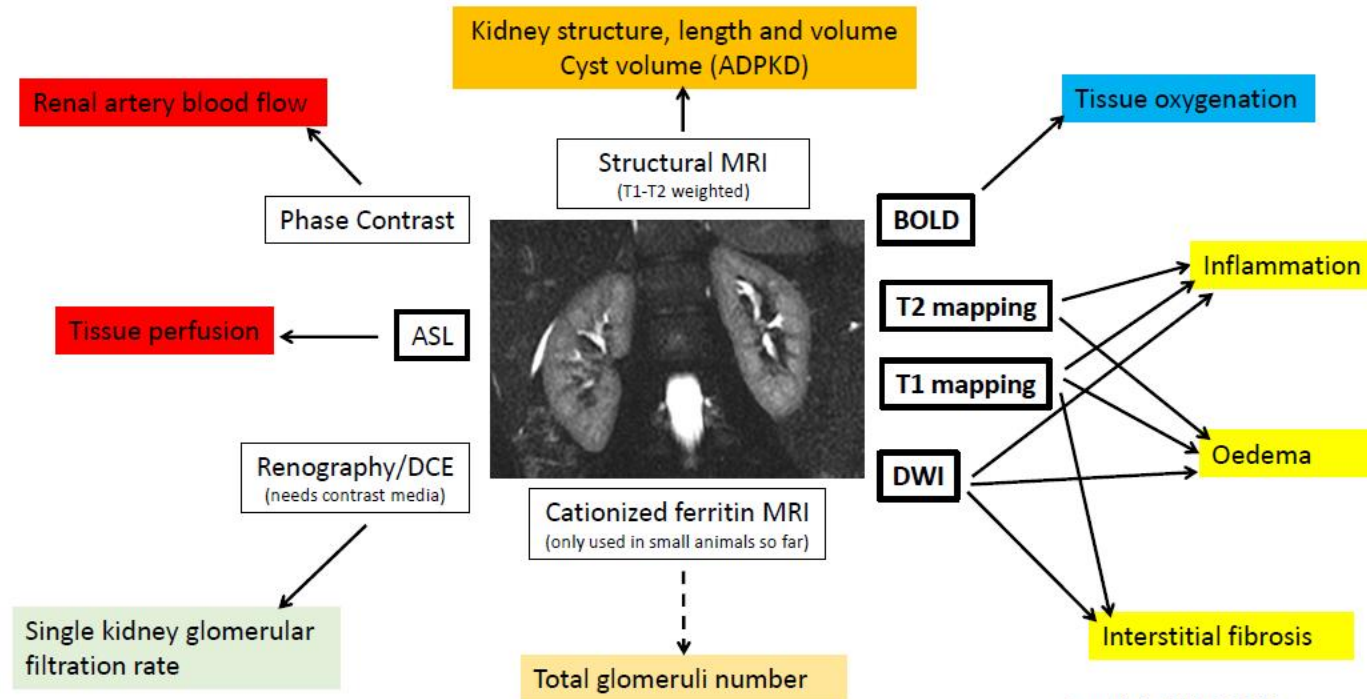


MRC: 1 patient sur 1000
aura besoin de dialyse

Nouvelles techniques radiologiques



IRM
fonctionnelle

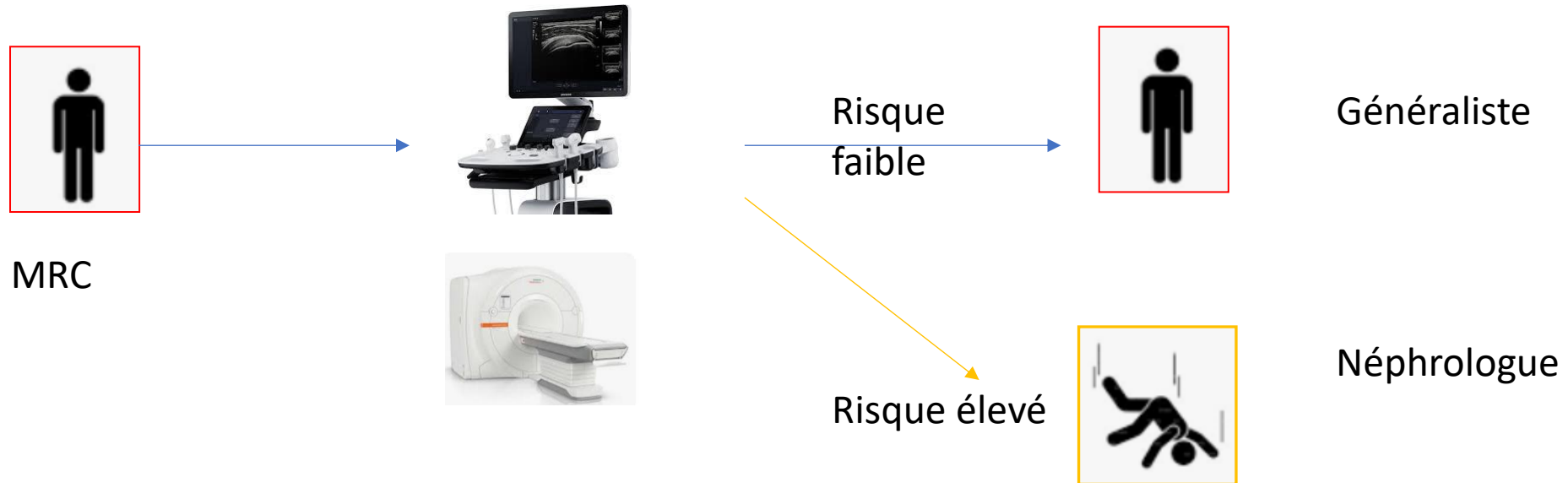


Caroli A, NDT 2018



CEUS
US à microbulles

Futur: consultation néphrologie



Quand référer?

Référer au néphrologue si

- IRA ou chute brutale et persistante du DFGe
- IRC d'origine inconnue
- DFGe $< 30 \text{ ml/min/1.73m}^2$
- ACR systématiquement $> 300 \text{ mg/g}$ (30 mg/mmol)
- Progression de l'IRC/détérioration du DFGe
- Microhématurie glomérulaire
- IRC + hypertension résistante
- Anomalies persistantes du potassium sérique
- Maladie rénale héréditaire
- Néphrolithiase récurrente ou étendue



Mythe 3: on ne peut rien faire

G1			G2			G3a			G3b			G4			G5		
A1	A2	A3	A1	A2	A3	A1	A2	A3	A1	A2	A3	A1	A2	A3	A1	A2	A3
						Lifestyle modification											
						Smoking cessation											
						Optimize blood pressure control											
						RAS inhibition*											
						Statins ✕											
						Optimize glycemic control											
						SGLT2 inhibitors*#											
						GLP1 receptor agonists#											
						Finerenone §											
						Treat metabolic acidosis											
Avoid nephrotoxins, adjust medication dosages, review drug interactions and contraindications																	

Ralentir le déclin de la fonction rénale:

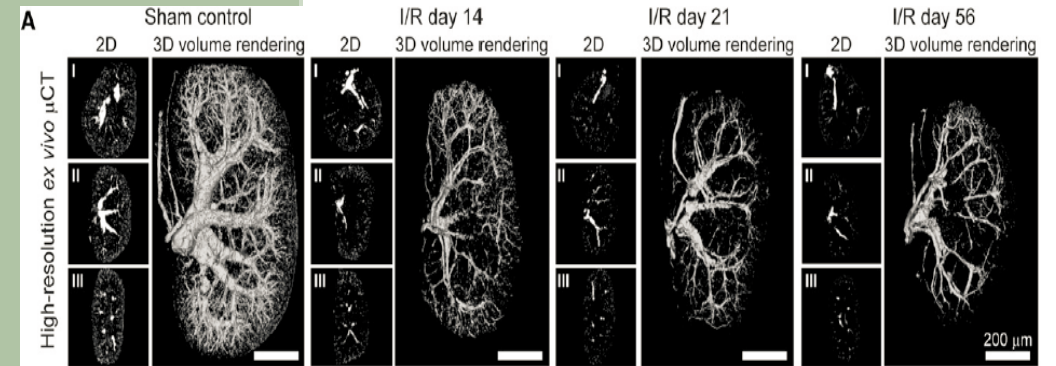
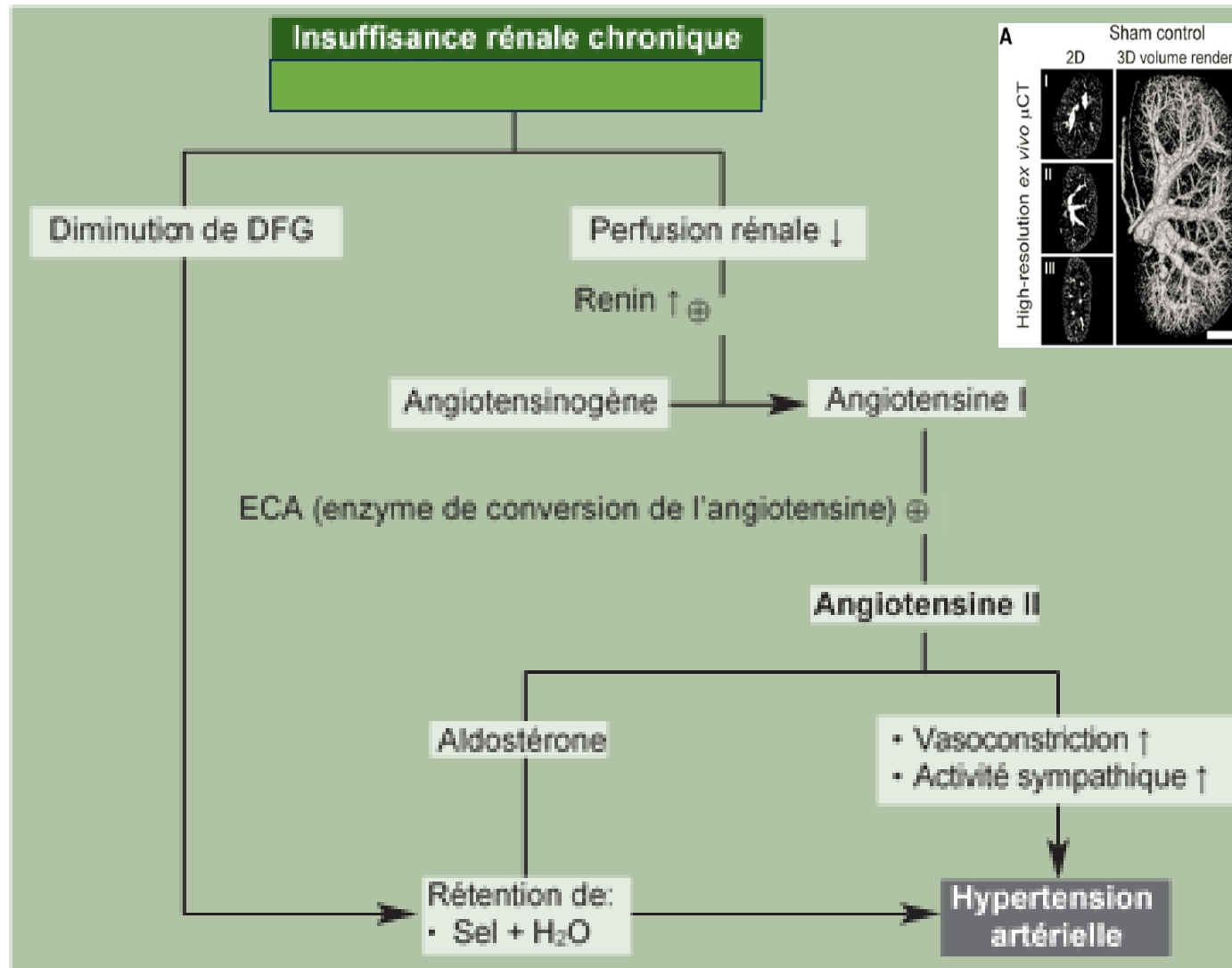
- Activité physique-perte de poids
- arrêt tabac
- Consommation sel <5g/j
- Consommation protéines 0.8g/kg/j
- Vaccination annuelle Influenza, SARS-CoV2; Pneumococ
- Contrôler le profil tensionnel et lipidique
- Diminuer la protéinurie (iRAS)
- Introduction de nouvelles classes de traitement
 - Inhibiteurs SGLT2
 - Antagonistes sélectifs du récepteur minéralocorticoïde
 - Agonistes GLP-1
 - Combinaisons
- Traiter les complications (acidose métabolique)



Etude 5145 patients T2D + surpoids
Randomisés à info vs activité >170min/sem +perte de poids de 7%, suivi 10ans
Diminue le risque d'IRC de haut risque HR 0,69



Hypertension artérielle et MRC



Inhibiteurs du système
rénine-angiotensine

IEC: lisinopril, enalapril,..
Sartan: valsartan,..



Seuil TA:

KDIGO 2021

Toutes les stades G1-4:

TA “standardisée” au cabinet <120/80mmHg, si tolérée

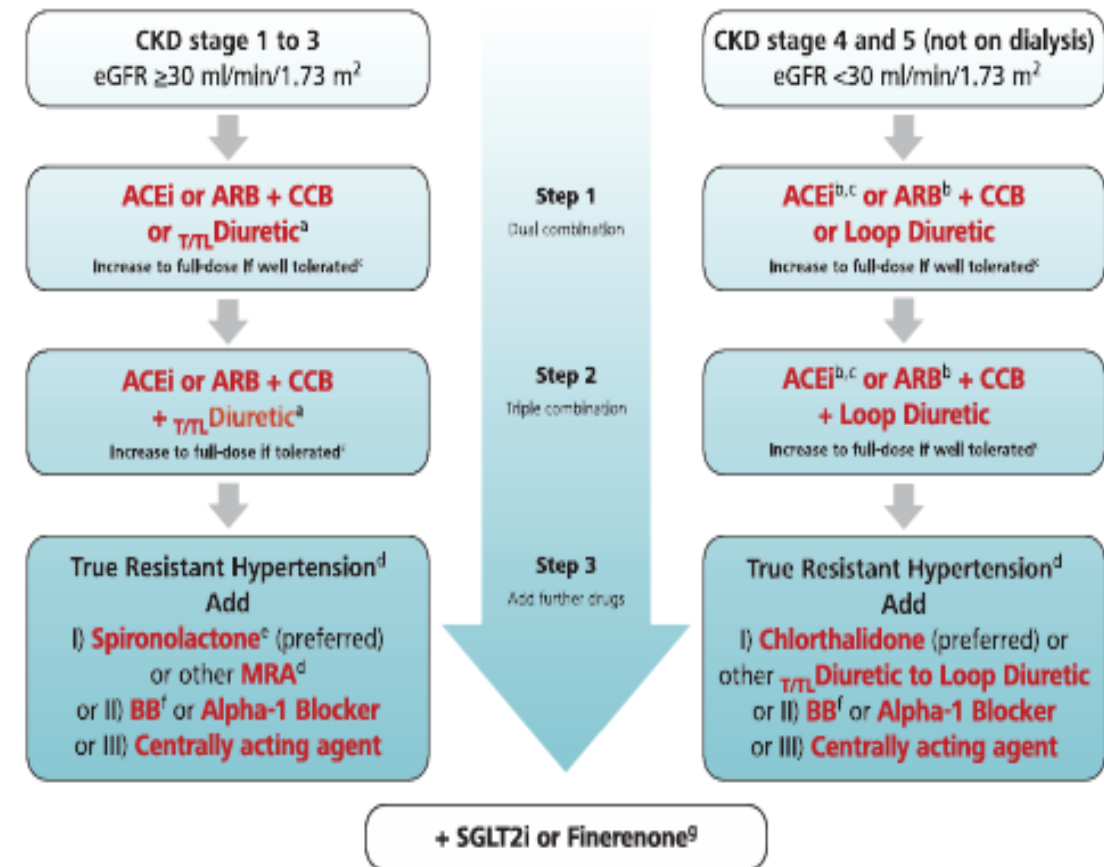
ESH 2023

Tous: TA cabinet <140/90mmHg

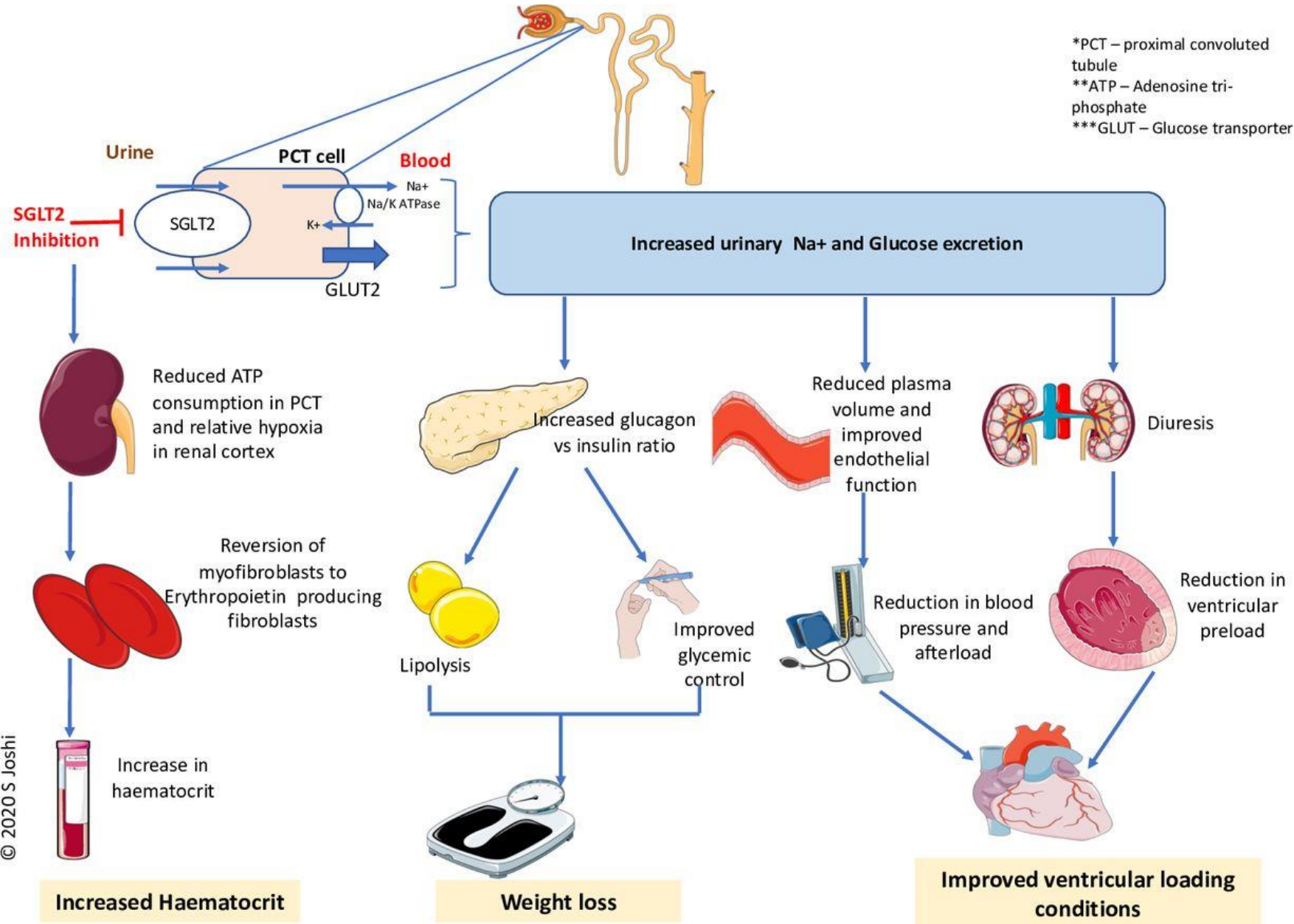
TA cabinet <130/80mmHg si tolérée

Choix du traitement:

- Inhibiteurs système rénine-angiotensine (iRAS) si MRC G1-4 et A2-3
- Très souvent en association avec anticalciques
- Ou diurétiques
- Ajouter spironolactone, BB, alpha bloquant si TA résistante



SGLT2i (Sodium GLucose co-Transporter-2 inhibitors)

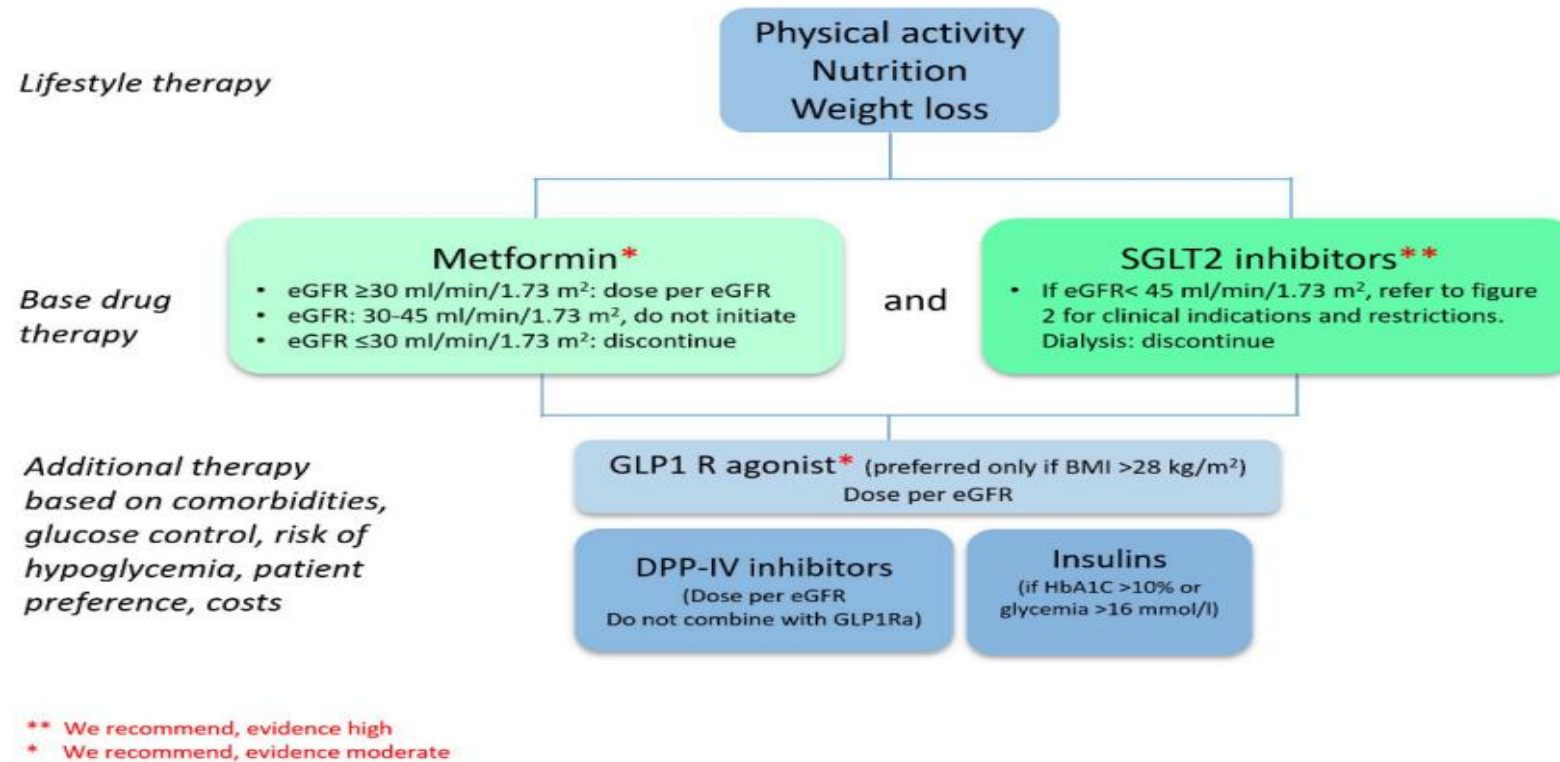


Forxiga[®] = dapagliflozin
 Jardiance[®] = empagliflozin
 Invokana[®] = canagliflozine

This figure was created using Servier medical art. <http://smart.servier.com>

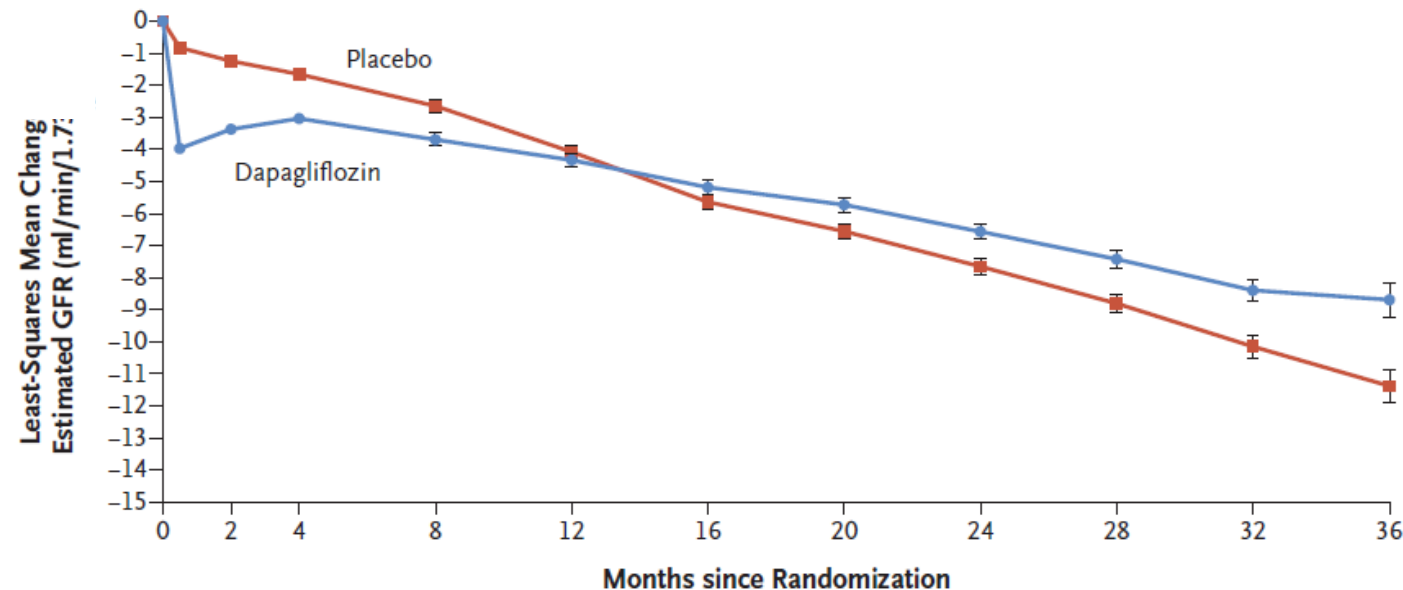
SGLT2i: première ligne de traitement de patients diabétiques avec MRC

Figure 2: Antidiabetic therapy in chronic kidney disease stage G1–3 A2–3 (modified from: Kidney Disease: Improving Global Outcomes (KDIGO) Diabetes Work Group. KDIGO 2020 Clinical Practice Guideline for Diabetes Management in Chronic Kidney Disease. Kidney Int. 2020 Oct;98(4S):S1-S115 [1]). Per eGFR see figure 1. Comment: dual SGLT2 inhibitor – GLP1 agonist therapy is under investigation. Preliminary results demonstrate additional effects on weight, blood glucose and blood pressure control.



Dapa-CKD trial:

- CKD patients with (2/3) or without (1/3) DM, eGFR 25-75 ml/min and albuminuria >200mg/day (ACR >200mg/g)
- Dapagliflozine 10mg (Forxiga) vs placebo



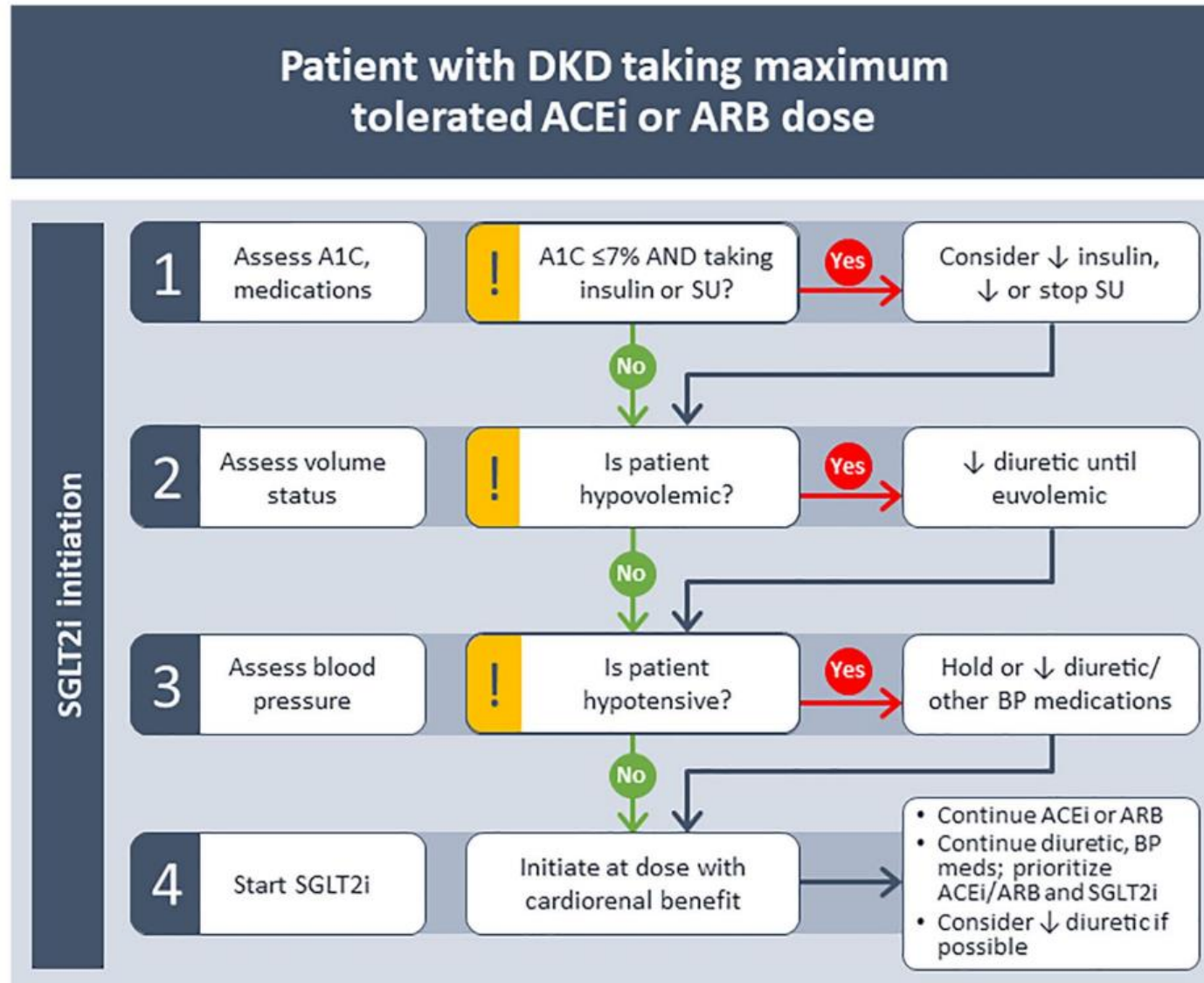
No. of Participants

Placebo	2152	2029	1981	1866	1795	1753	1672	1443	935	447	157
Dapagliflozin	2152	2031	2001	1896	1832	1785	1705	1482	978	496	157

- N= 4304
- Endpoint: Reduction in eGFR decline of at least 50%, ESKD or death from renal or CV causes
- Occurred in 9.2% vs 14.5%, Relative Risk Reduction of 39%





Heerspink et al, NEJM 2020

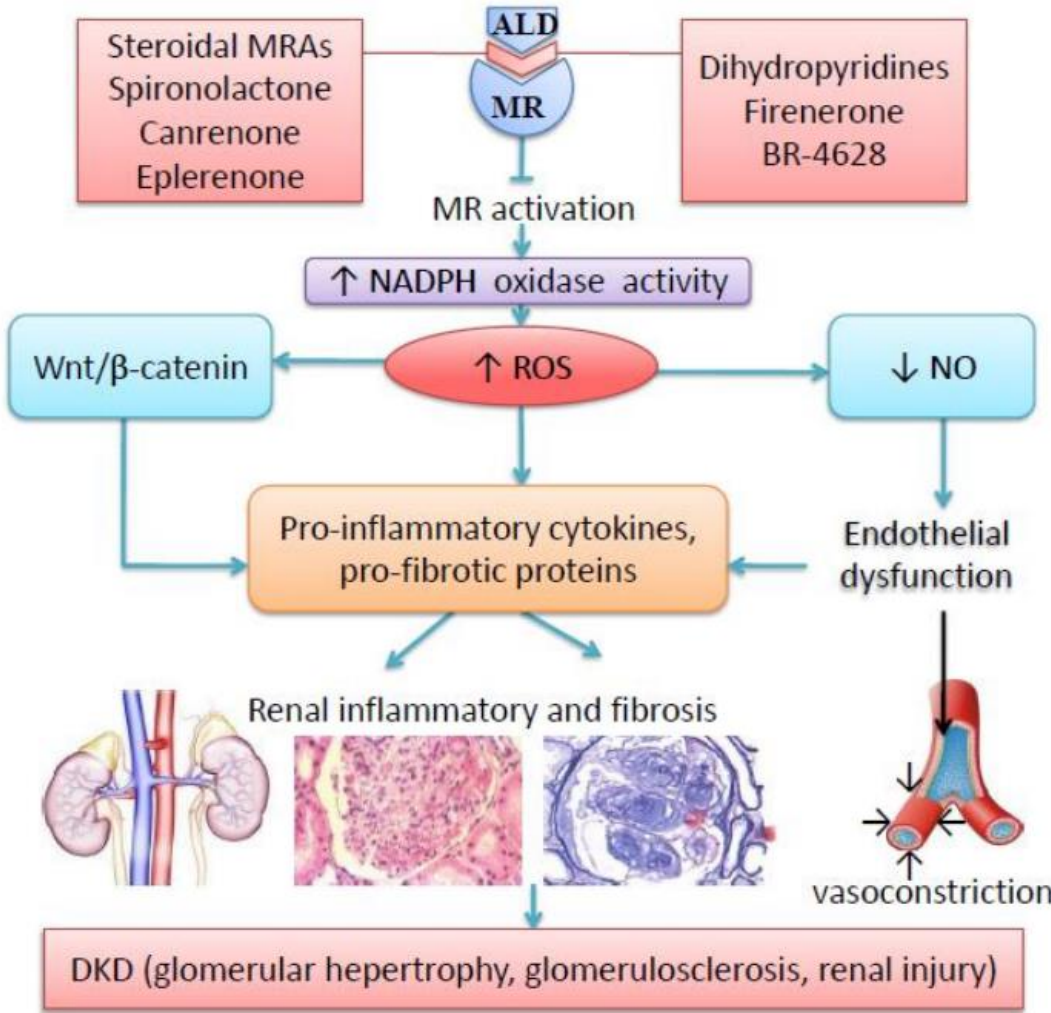
Practical points: Canadian guidelines



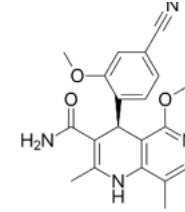
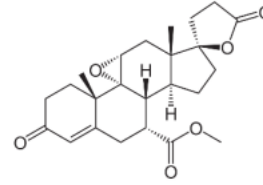
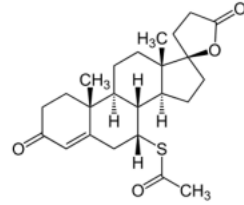
Cherney D, Canadian J of
Kidney Health and Disease
2023













Finérénone (Kerendia): antagoniste sélectif non-stéroïdien du récepteur des minéralo-corticoïdes

	Spirolactone	Canrenone	Eplerenone	Finerenone
Chemical structure				
Class	Steroidal	Steroidal	Steroidal	Dihydropyridine
MR IC50 (nM)	24	≥1000	990	17.8
AR IC50 (nM)	77	N/A	≥ 21 240	≥ 10 000
GR IC50 (nM)	2410	≥ 1000	≥ 21 980	≥ 10 000
PR EC 50 (nM)	740	N/A	≥ 31 210	≥ 10 000
Half-life (h)	1.4 (active metabolites 12–35)	16.5	4-6	2

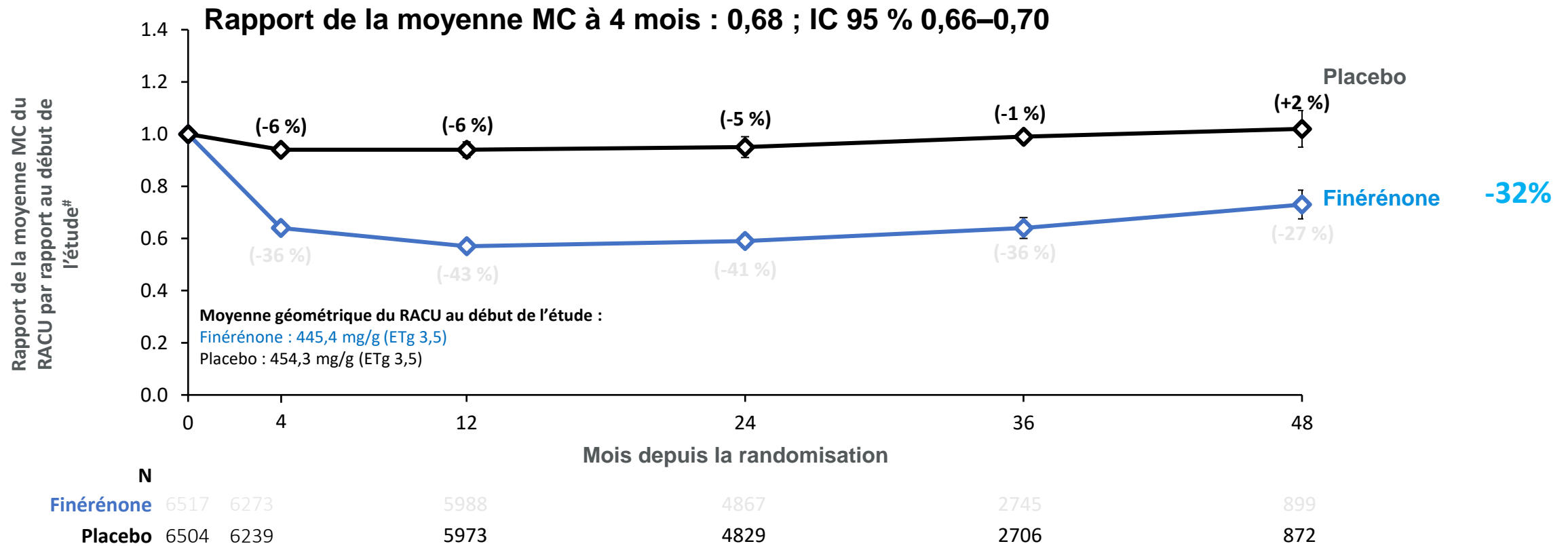


Finerénone: moins d'hyperkaliémie



Characteristics	Spironolactone	Eplerenone	Finerenone
MR antagonist class	Steroidal		Non-steroidal
Structural prop.s	Flat	Flat	Bulky
Potency			
Selectivity			
MR IC ₅₀ (nM)	24	990	17.8
GR IC ₅₀ (nM)	2,410	≥ 21,980	≥ 10,000
AR rec. IC ₅₀ (nM)	77	≥ 21,240	≥ 10,000
PR EC ₅₀ (nM)	740	≥ 31,210	≥ 10,000
OR α & β IC ₅₀ (nM)	5,970 & 4,940	≥ 30,000 & ≥ 30,000	≥ 10,000 & ≥ 10,000
Metabolites	Multiple, active	No active	No active
Half-life	>20:0H	4-6:0H	2-3:0H
Tissue distribution in rodents	 1  >6	 1  ~3	 1  1
CNS penetration	+	+	-
Effect on BP	+++	++	+
Excretion (unchanged)	<1%	<3%	<1%

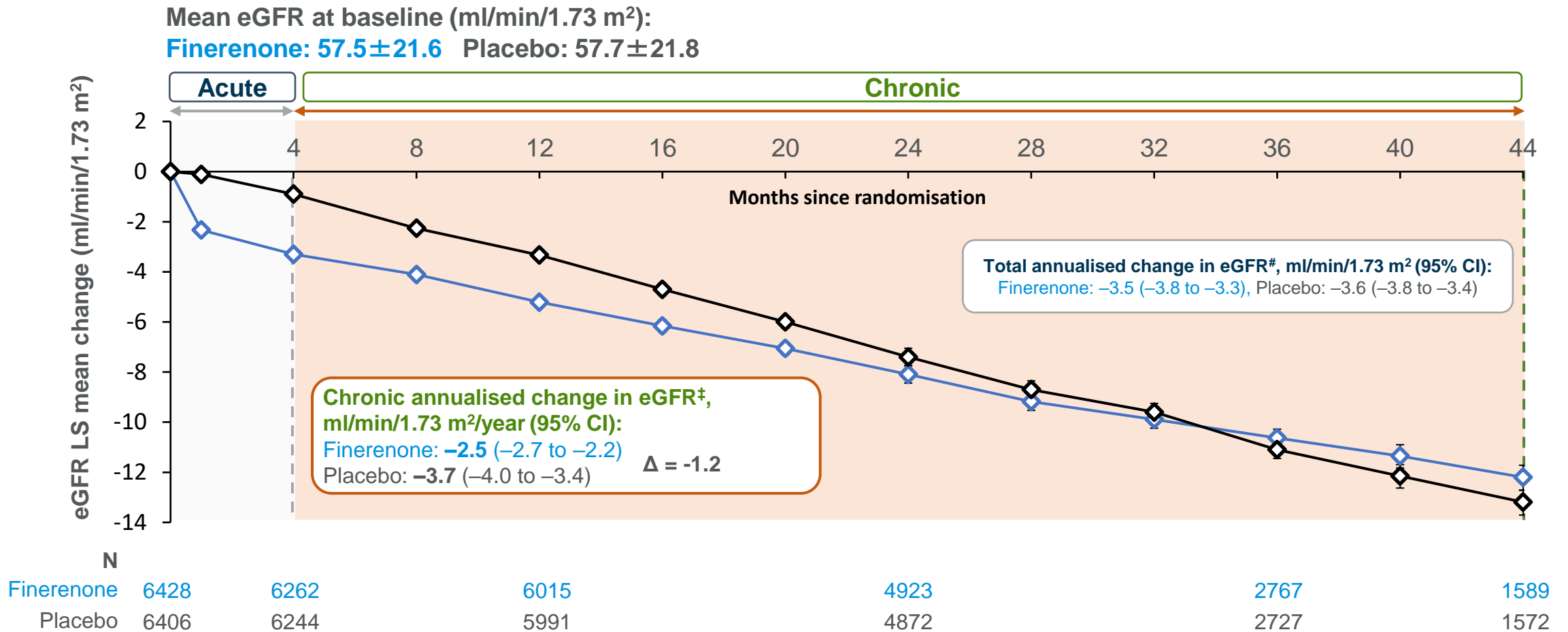
Etude FIDELITY: Réduction du ACR au fil de temps



Les données entre parenthèses représentent la modification moyenne par rapport à la valeur initiale ; ensemble d'analyse intégral. Modèle mixte avec des facteurs de groupe de traitement, région, catégorie de DFGe à la sélection, type d'albuminurie à la sélection, durée, durée du traitement, temps des valeurs de début d'étude log-transformé en tant que covariable. Les modèles de covariance déstructurés distincts sont estimés pour chaque groupe de traitement.

[#]Les données sont la moyenne MC / IC 95 %. IC, intervalle de confiance ; DFGe, débit de filtration glomérulaire estimé ; ETg, écart-type géométrique ; MC, moindres carrés ; RACU, rapport albumine/créatinine dans l'urine

Etude FIDELITY: Réduction de la pente du DFGe



Mixed model analysis of eGFR over time. Full analysis set; [#]LS mean change in eGFR slope from baseline to the permanent discontinuation or end-of-study visit; [‡]LS mean change in eGFR slope from month 4 to the permanent discontinuation or end-of-study visit

CI, confidence interval; eGFR, estimated glomerular filtration rate; LS, least-squares

Bakris GL, et al. Kidney Int. 2023; 103: 196-206

Finerénone:



- **DM type 2**
- **eGFR $\geq 25-60$ ml/min/1.73m²**
- **ACR ≥ 3 mg/mmol**
- **K < 5 mmol/l**
- **Sous IEC ou sartan, dose max**

***OU** un DFGe de 25-75 ml/min/1.73m², et un ACR > 30 mg/mmol*

*En **association avec des inhibiteurs du SGLT2**, uniquement chez les patients présentant un DFGe de 25-59 ml/min/1.73m² et un rapport albumine/créatinine urinaire > 30 mg/mmol*

Check K après 4 semaines

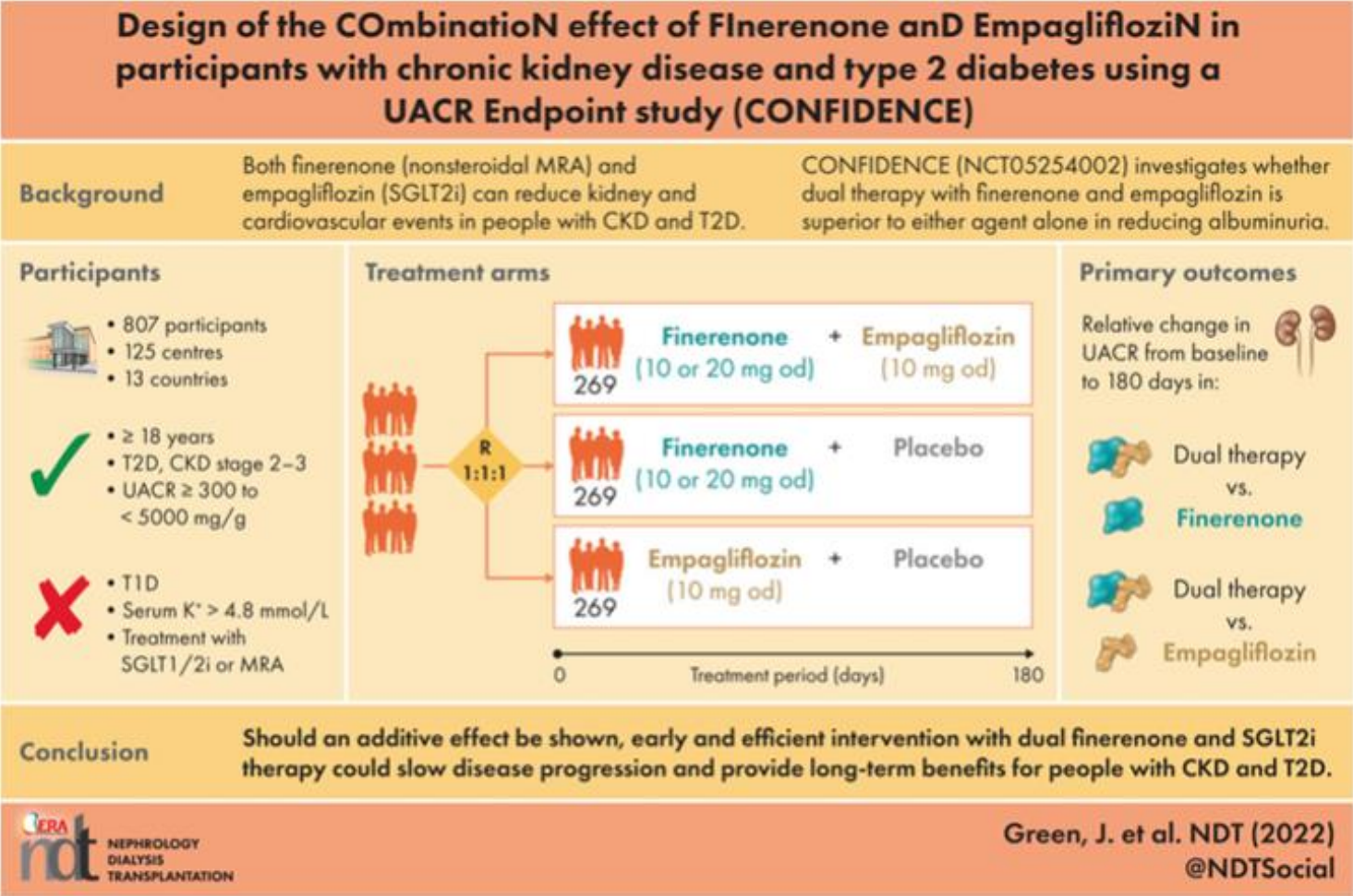
Si K < 4.8 mmol/l, augmenter dose à 20mg/j

Si DFGe > 60 ml/min, débuter directement 20mg/j

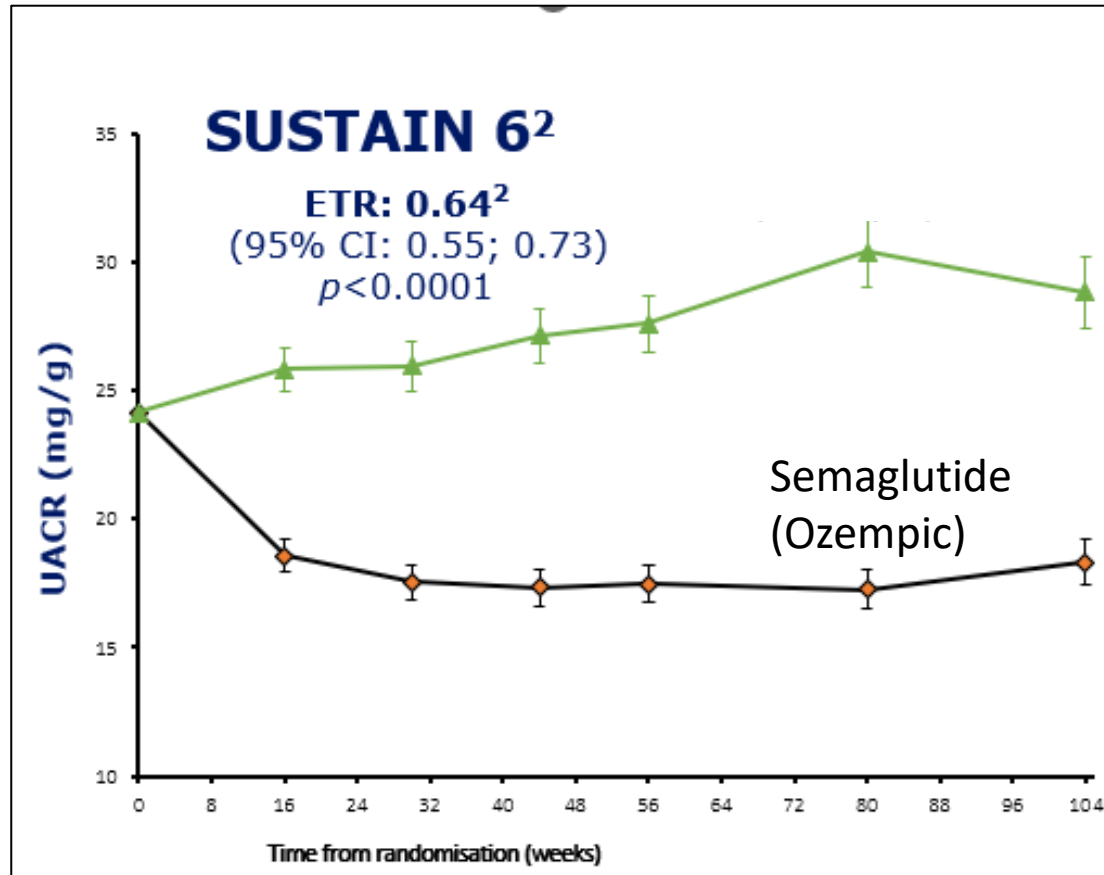


Design of the COmbination effect of FInerenone and EmpaglifloziN in participants with chronic kidney disease and type 2 diabetes using a UACR Endpoint study (CONFIDENCE)

Jennifer B. Green^{1,*}, Amy K. Mottl^{2,*}, George Bakris³, Hiddo J. L. Heerspink⁴, Johannes F. E. Mann⁵, Janet B. McGill⁶, Masaomi Nangaku⁷, Peter Rossing^{8,9}, Charlie Scott¹⁰, Alain Gay¹¹ and Rajiv Agarwal¹²



GLP-1 agonistes et patients diabétiques avec MRC



Direct effects:

- Natriuresis
- Haemodynamic effects in the setting of diabetic glomerular hyperfiltration
- Inhibition of RAAS
- Reduced oxidative stress
- Anti-inflammatory effects



GLP-1

Indirect effects:

- Improved glycaemic control
- Reduction in blood pressure
- Weight loss



Semaglutide for CKD in Patients with Type 2 Diabetes: “FLOW”ing with the Semaglu“TIDE”



METHODS



International, double-blind, placebo-controlled 28 countries



Type 2 DM and CKD:

GFR 50-75 ml/min +
ACR 300-5000 mg/g
or



GFR 25-<50 ml/min +
ACR 100-5000 mg/g



Median follow-up,
3.4 years



Major kidney disease events



Death from any causes



Adverse event leading to discontinuation



Major kidney disease events- kidney failure, $\geq 50\%$ reduction in GFR, death from CV or kidney-related causes

Placebo

n = 1766



7.5 events
per 100
patient-years

279(15.8%)

211(11.9%)



HR 0.76

(95% CI, 0.66-0.88)

HR 0.80

(95% CI, 0.67-0.95)

Semaglutide

n = 1767



5.8 events
per 100
patient-years

227(12.8%)

233(13.2%)

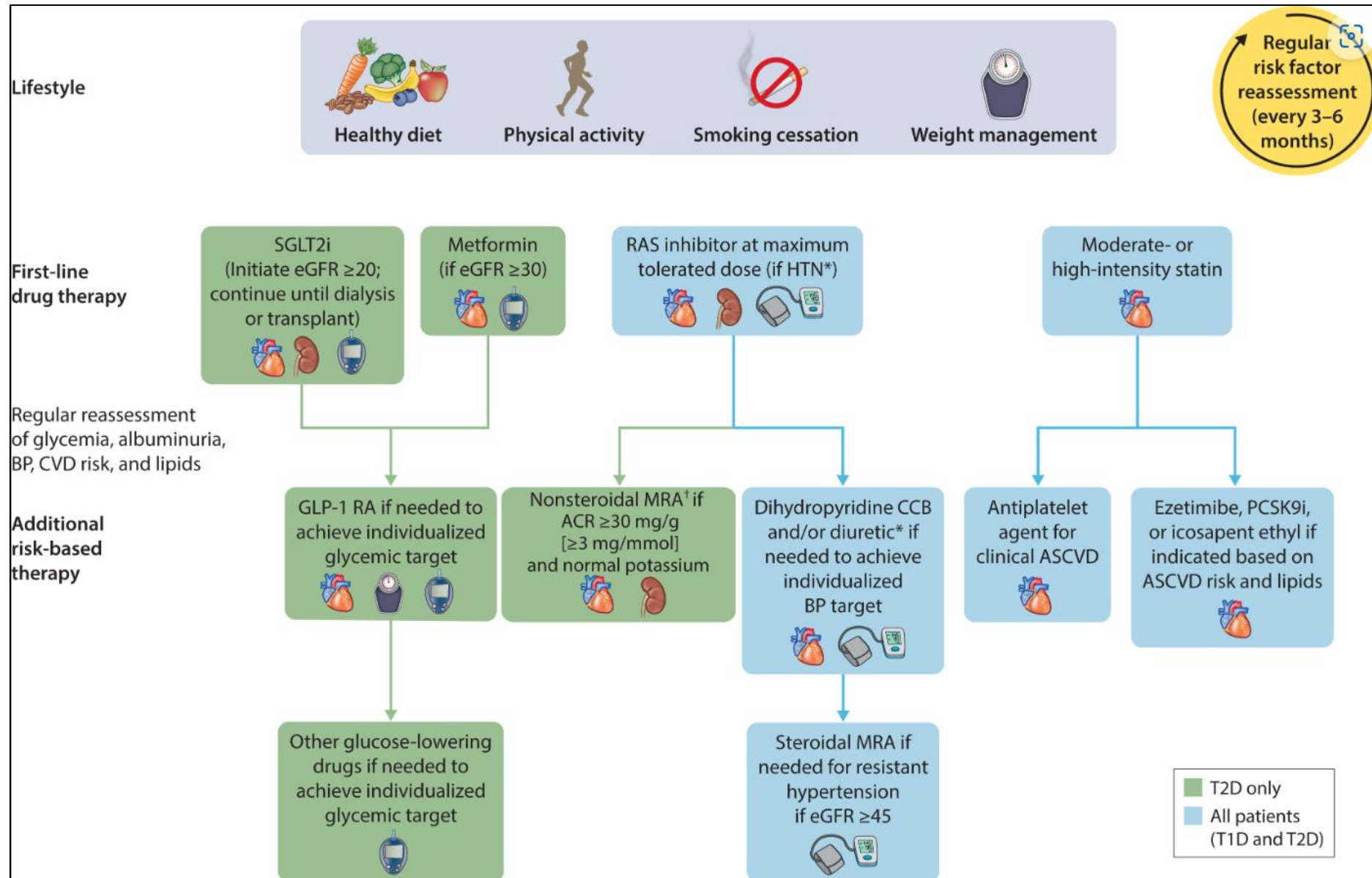
HR= Hazard ratio

Reference: Perkovic,V et al. Effects of Semaglutide on Chronic Kidney Disease in Patients with Type 2 Diabetes. NEJM, May 2024.

VA by Anjana Gopal X @anjanagopal9

Conclusion: Semaglutide reduced the risk of clinically important kidney outcomes and death from cardiovascular causes in patients with type 2 diabetes and chronic kidney disease.

KDIGO 2022 CLINICAL PRACTICE GUIDELINE FOR DIABETES MANAGEMENT IN CKD



Lipides:

- Statine +/- ezetimibe pour tous les patients MRC G3-5 ND
- LDL: Pas de cible sauf si très haut risque:
 - Patients avec DM et maladie CV établie
 - Patients avec DM et MAU
 - Patients avec DM et DFG <45 ml/min



	CKD stage/risk category	Treatment	LDL cholesterol goal
EAS/ESC, 2021	Very high >G3b or G3aA2 or A3	High intensity statin (Class IA) ± ezetimibe (Class IB) / PCSK9 inhibitor (Class IIbC)	Step 1: <1.8 mmol/l and 50% reduction from baseline
			Step 2: <1.4 mmol/l* (if established ASCVD Class IA, if not IIbC)

Zanchi, Seeger, SMW 2023
KDIGO guidelines

Etude SHARP

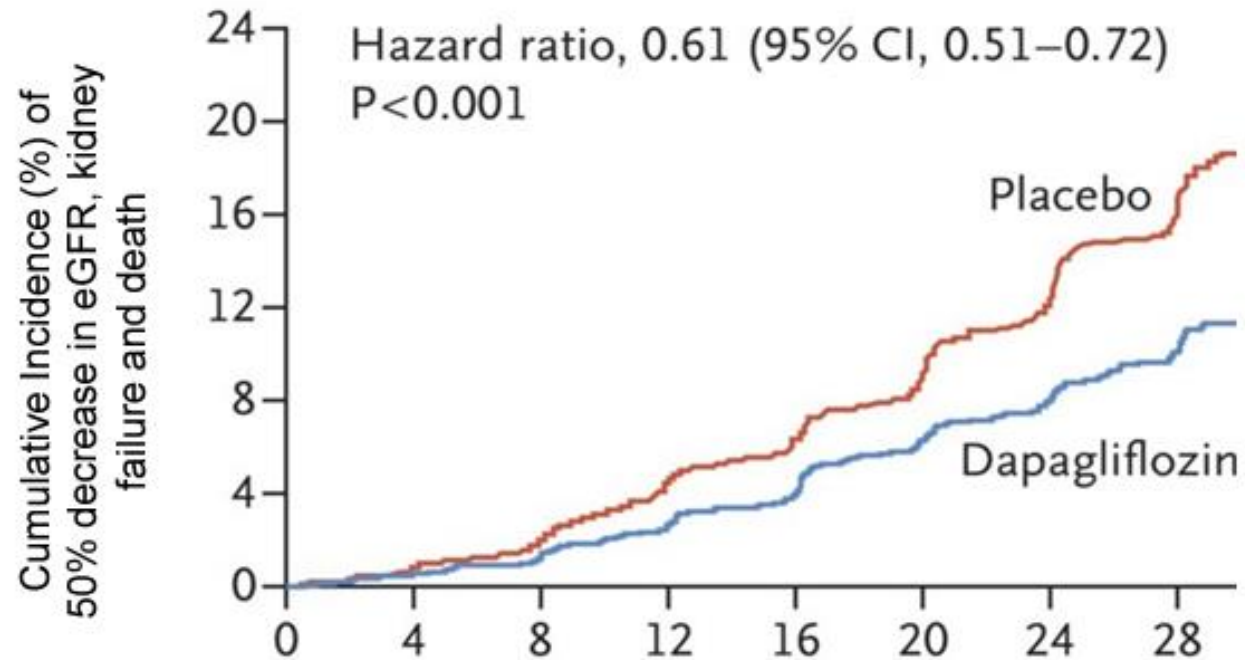


Repatha (evolocumab) SC 1x/2-4sem
Praluent (alrocumab)

Monsieur M, 65 ans

- AC: HTA depuis 15 ans, tt amlodipine 10mg/j
- Check up:
 - Créatinine 200 $\mu\text{mol/l}$, K 4.7 mmol/l , chol 4.0 mmol/l , LDL 2.8 mmol/l
 - DFG 29 ml/min/1.73m^2
 - ACR 25 mg/mmol
- Que faites vous?
 - Cible TA: <120/80mmHg
 - Ajouter IEC ou sartan jusqu'à dose max
 - Dans un 2me temps, ajouter iSGLT2
 - Ajouter statine/ézétimibe
 - Futur?

Residual risk despite medical treatment

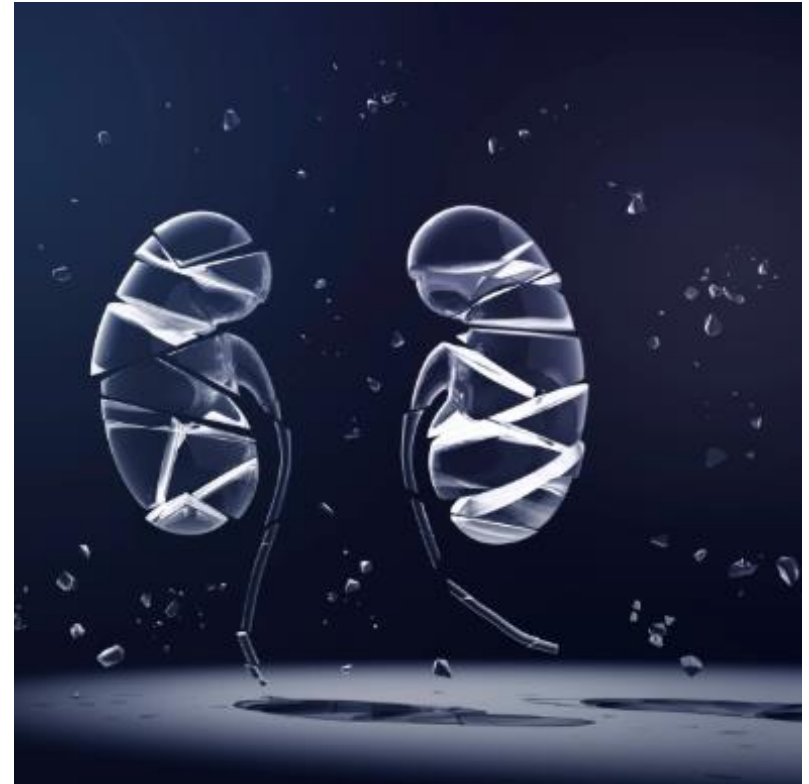


Dapagliflozin: 19 patients required treatment to prevent one primary outcome event

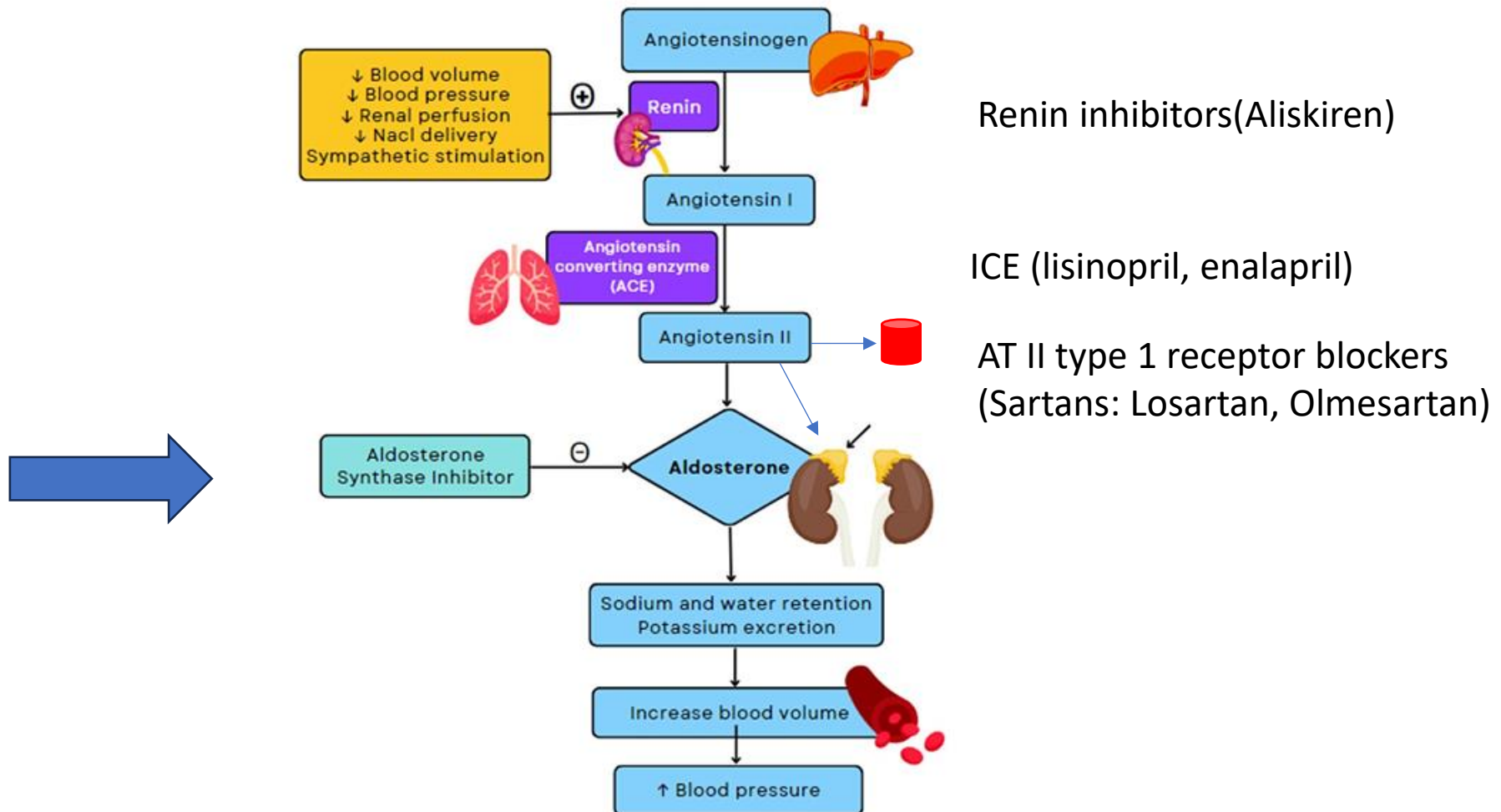
Nouveaux traitements nécessaire!

Future developments to reduce residual risk

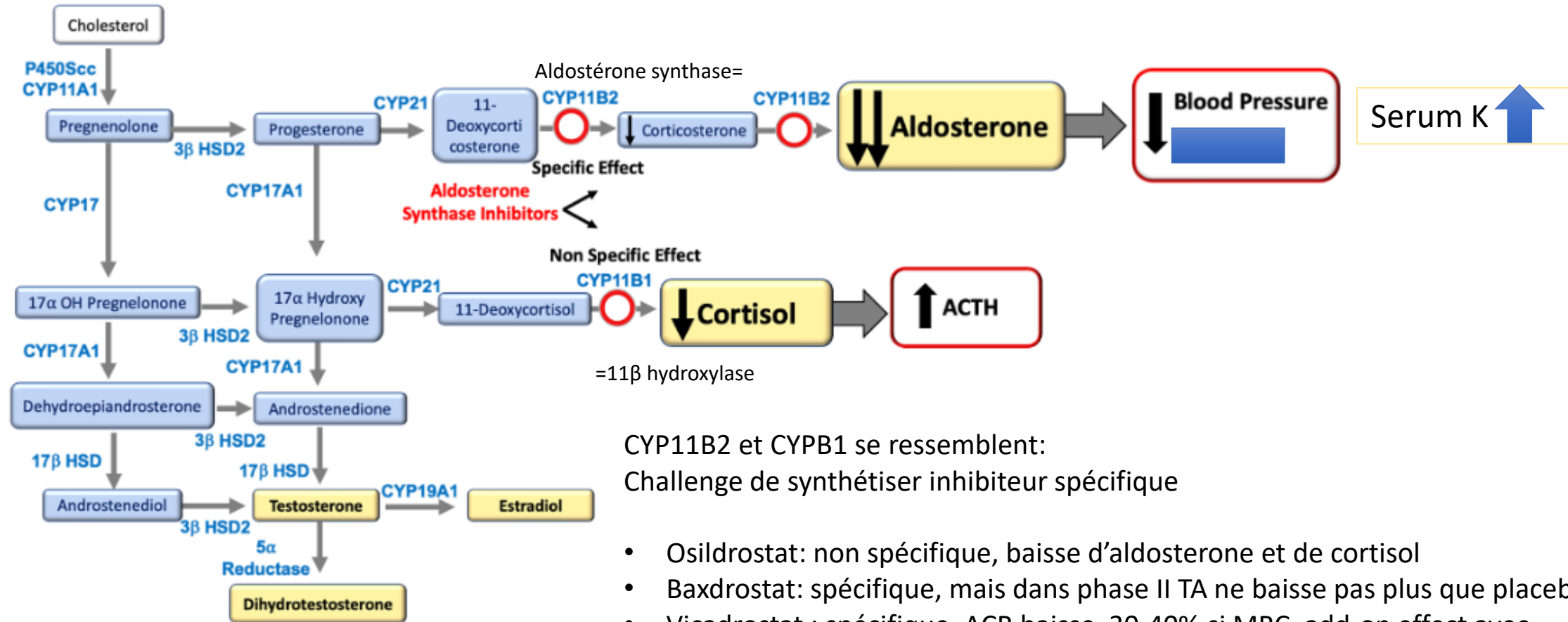
- New drugs to block renin-angiotensin system
- Regenerative therapies
- ...



Aldosterone synthase inhibitors

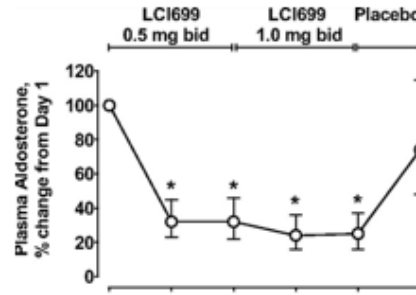


Les inhibiteurs de l'aldosterone synthase

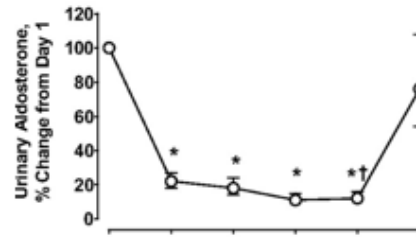


Effet du blocage de l'aldosterone synthase sur l'aldosterone plasmatique et urinaire

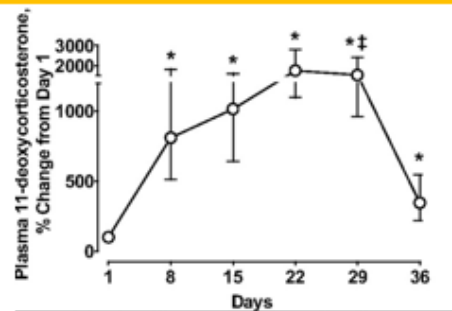
Plasma
aldo



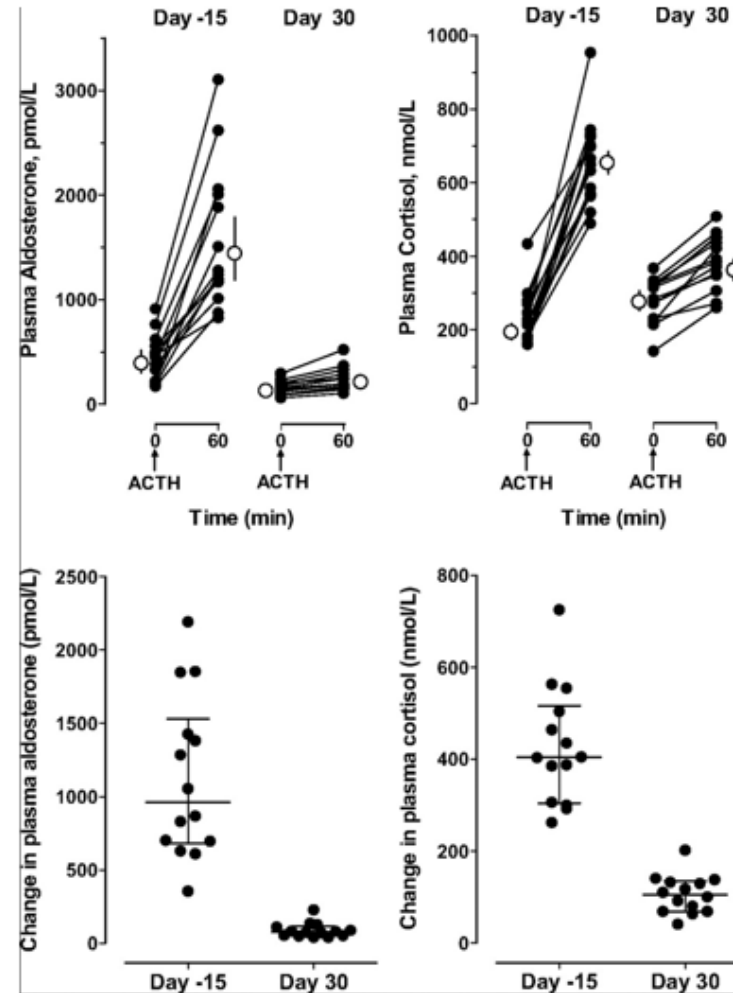
Urine
aldo



11deoxy-
corticostérone



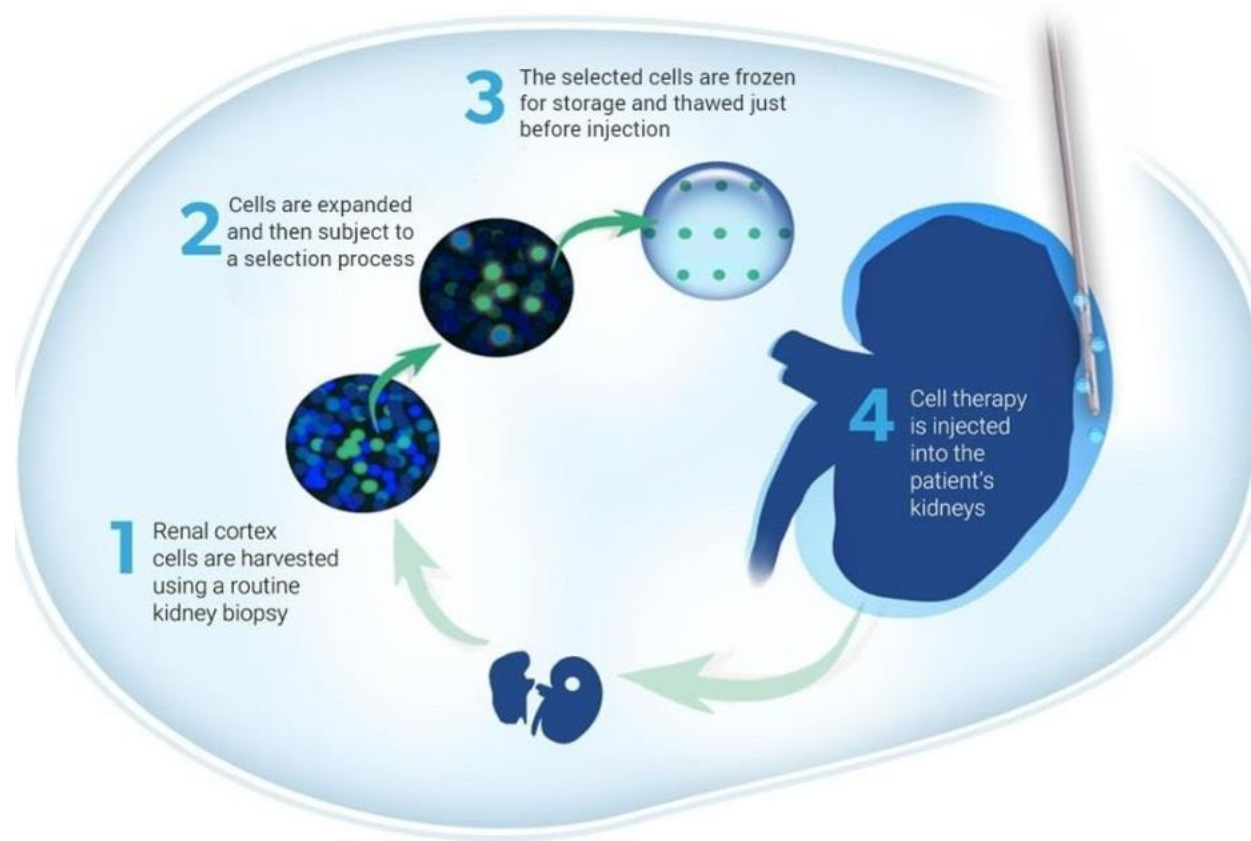
LCI699=osilodrostat



Augmentation d'aldosterone moins important après administration de 250 ug d'ACTH si tt avec LCI699 (inhibiteur aldosterone synthase)

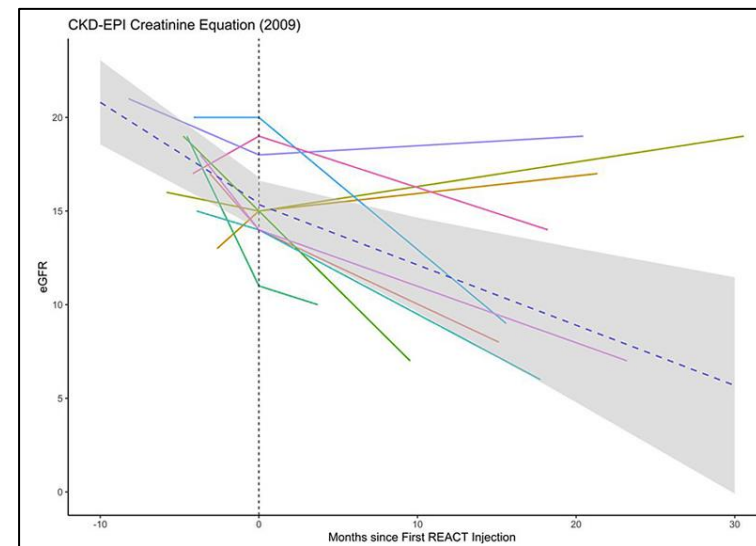
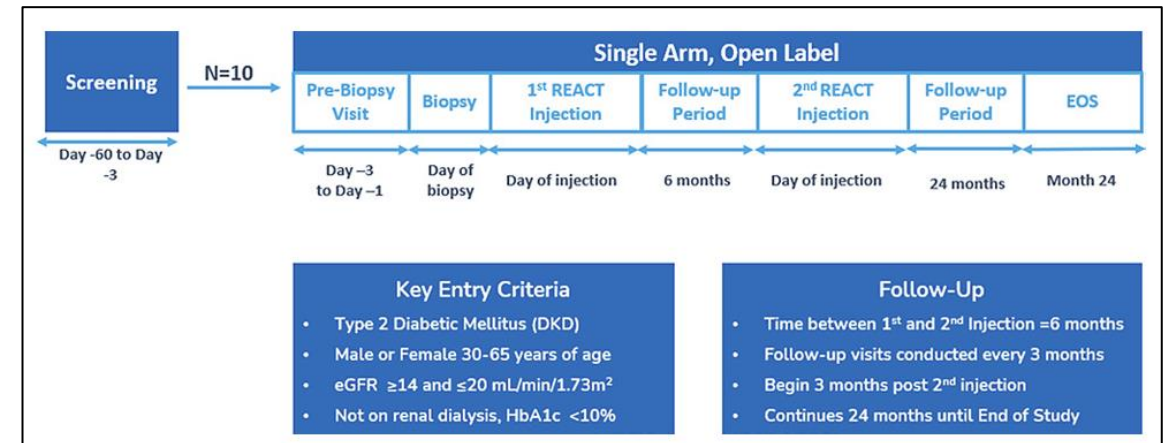
Malgré tout, aussi baisse de cortisol Avec osildrostat

Prokidney is developing a renal autologous cell therapy (REACT)

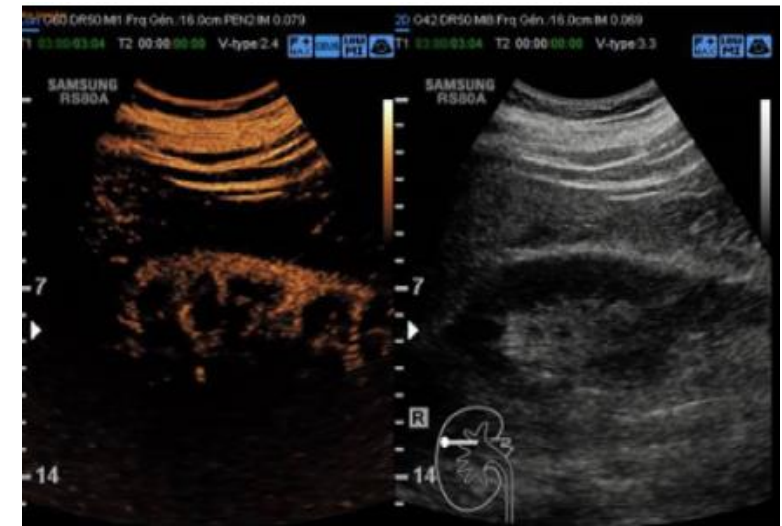
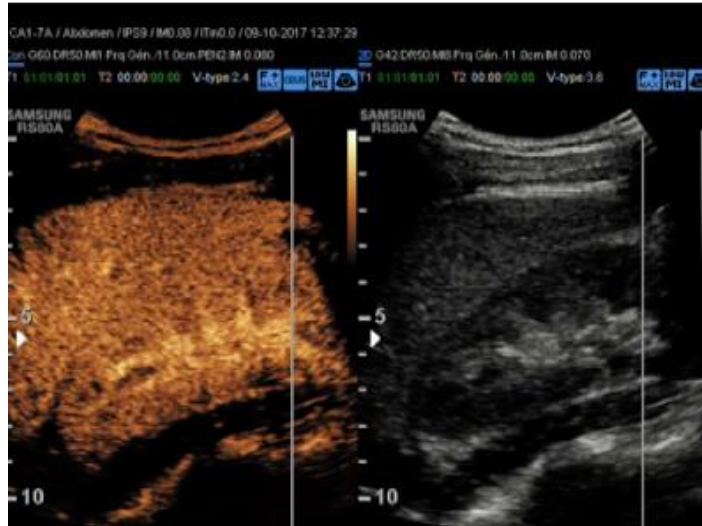
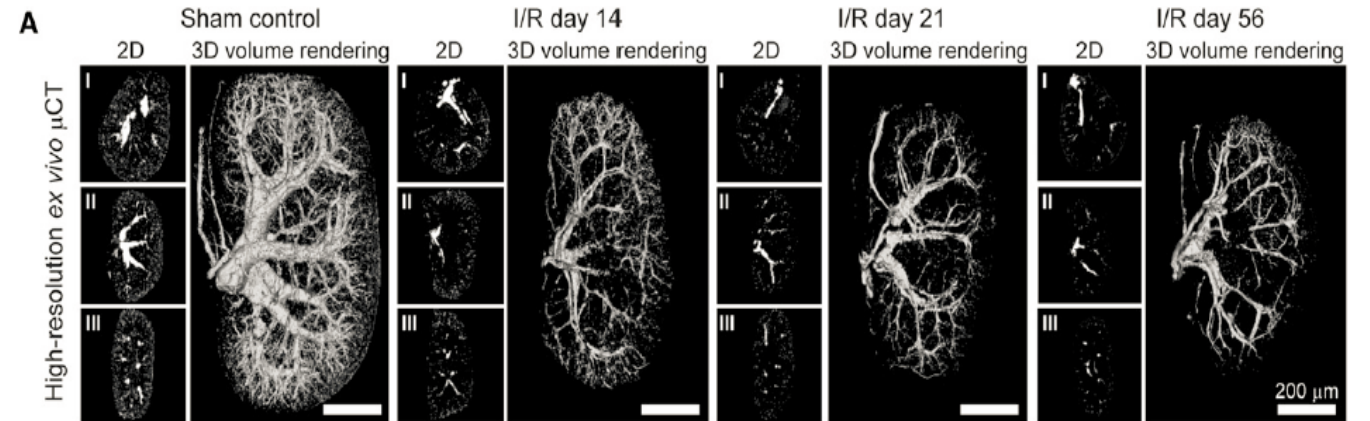
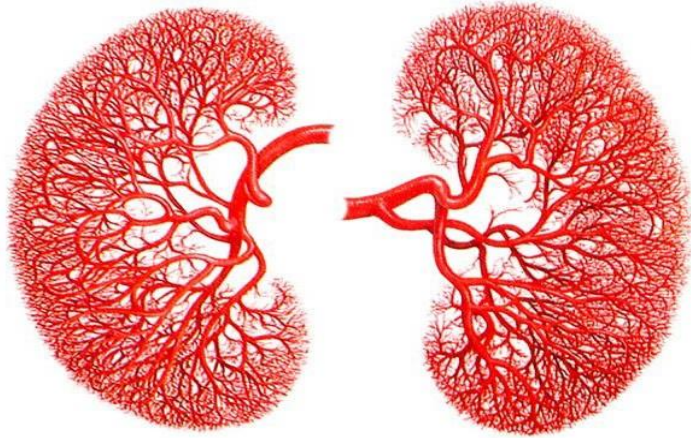


Renal Autologous Cell Therapy in Type 2 Diabetes with Late Stage 4 Diabetes-Related Chronic Kidney Disease: Trial Design and Early Analysis

- N=10 DM
- Age 59 ± 5.2 y, 50% male
- eGFR 16 ± 3 ml/min
- K 5.2 mmol/l
- Bicarbonate 19 mmol/l
- ACR 3.200 mg/g



MRC: perte de la micro-vascularisation



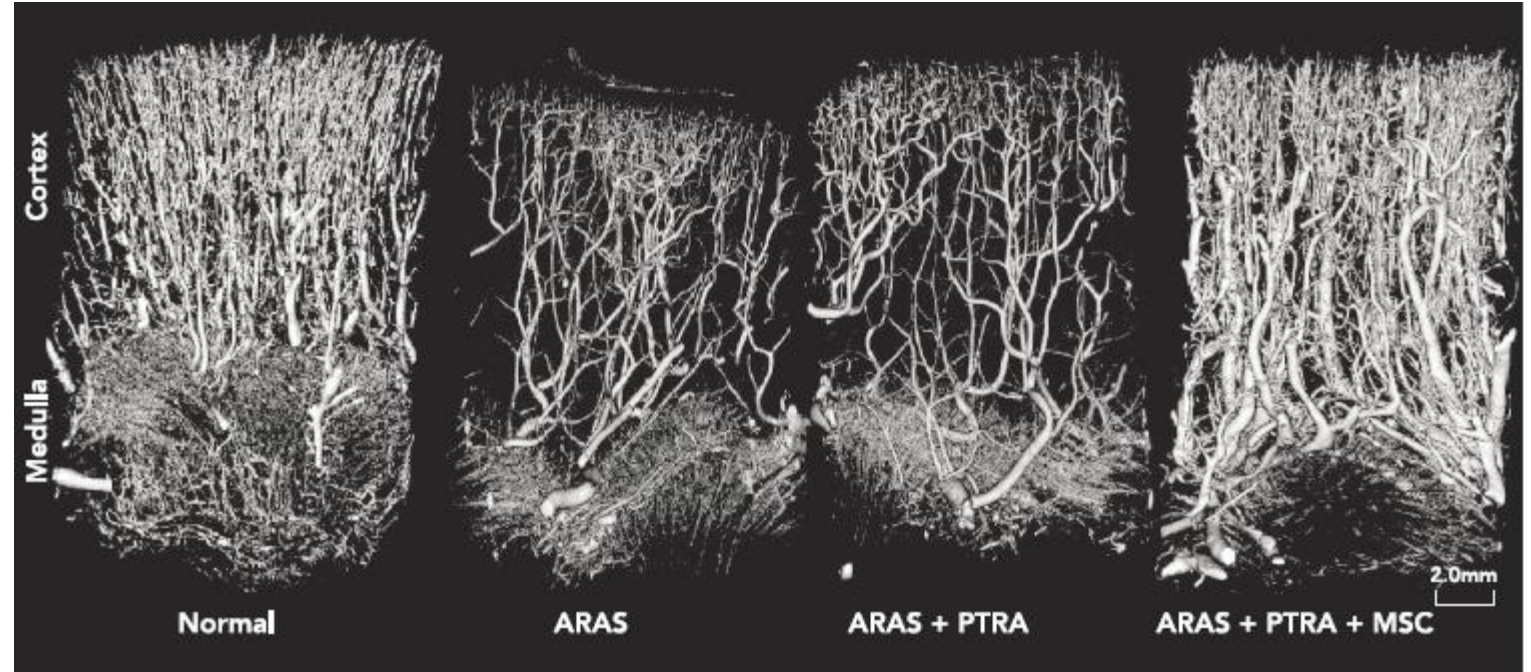
Andersen, Diagnostics 2020

Garessus, Pruijm, NDT 2021

Capillary rarefaction- Mesenchymal stem cell therapy



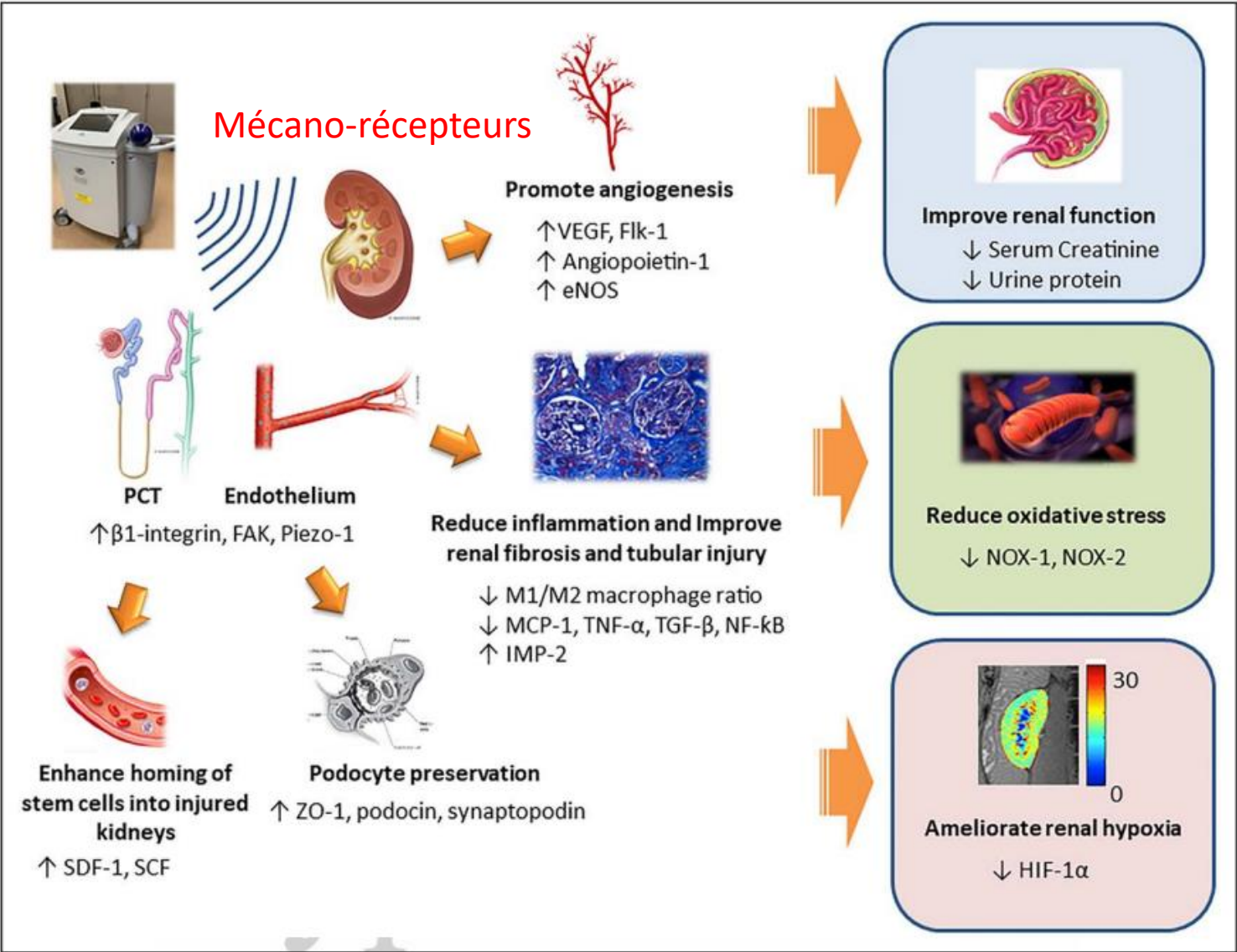
Sténose de l'a.rénale



Isoler, cultiver et réinjecter des cellules souches dérivés de la moelle ou cellules adipeuses peut stimuler la néo-angiogénèse

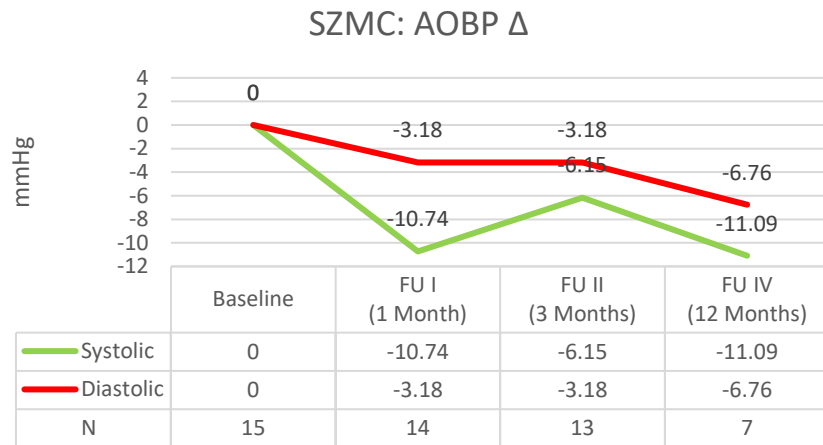
Risques: pro-oncogène; engraftment au mauvais endroit; couts

Mayo Clinic, étude chez les animaux (cochons): avec ondes de choc

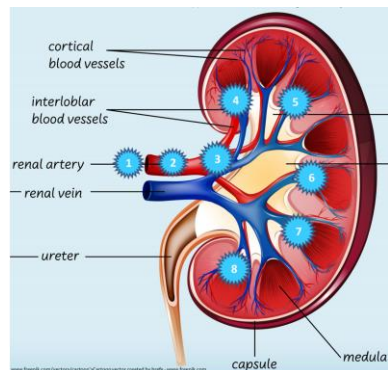


Results	Pre ShockWave	Post ShockWave
Generated new blood vessels in the kidneys		

Shockwave device for humans



Shockwave applicator



Ultrasound probe

www.curespec.com

Conclusions:

- MRC: plein d'options thérapeutiques
- Le futur réserve quelques «shocks»

