

*CKD: TWO
SIDES OF
THE STORY*

S. IQBAL

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DISCLOSURE

- No direct compensation
- Educational reasons: small educational grants for nephrology rounds speakers for nephrology rounds, teaching tool and students (no influence from the company)
 - Atrazeneca
 - Amgen
 - Ortho Janssen
 - Otsuka
 - Boehringer Ingelheim



CKD


- Conventional version

- describe the Definition of CKD
- Delineate the method of diagnosis
- Demonstrate the accepted approach of management
- Summarize the complications associated with CKD

- Iqbal version

- Describe the different types of CKD by diagnosis
- State the components of the dietary aspect is the main part of treatment

Definition and Diagnosis

- 
- Definition
 - Glomerular filtration is the flow of fluid from the glomerular capillaries into the Bowman's capsule. The volume filtrate formed per unit time is called **glomerular filtration rate**
 - Less than $60\text{ml}/\text{min}/1.73\text{ m}^2$ with three or more values using equations to estimate GFR

NKF 2002 clinical practice guidelines

- Chronic Kidney disease definition: Kidney damage for $>$ or $=$ 3 months defined by structural or functional abnormalities of the kidney, with or without GFR decrease
- Manifested by
 - a) pathological abnormalities
 - b) markers of kidney damage



Chronic kidney disease epidemiology collaboration (CKD-EPI)

The Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) formula developed is represented as the equation below, in which the values of the constants of a , b , and c vary on the basis of race, sex, and serum creatinine.

$$\text{GFR} = a \times (\text{serum creatinine}/b)^c \times (0.993)^{\text{age}}$$

The variable a takes on the following values on the basis of race and sex:

- **Black**
 - Women = 166
 - Men = 163
- **White/other**
 - Women = 144
 - Men = 141

The variable b takes on the following values on the basis of sex:

- Women = 0.7
- Men = 0.9

The variable c takes on the following values on the basis of sex and creatinine measurement:

- **Women**
 - Serum creatinine \leq 0.7 mg/dL = -0.329
 - Serum creatinine $>$ 0.7 mg/dL = -1.209
- **Men**
 - Serum creatinine \leq 0.9 mg/dL = -0.411
 - Serum creatinine $>$ 0.9 mg/dL = -1.209 (Reference: Levy et al, 2009 www.medscape.com/viewarticle/703213_print)

Management of CKD: Resources

- Drug dosing: <http://www.utdol.com/online/index.do>
- Calculating all formulas: http://nephron.org/MDRD_GFR.cgi
- Nephron app for phones

KDIGO classification 2012

KDIGO 2012 CLASSIFICATION OF CKD

GLOMERULAR FILTRATION RATE (GFR)

CATEGORY	GFR	EXPLANATION
G1	≥90	Normal or high
G2	60-89	Mild decrease
G3a	45-59	Mild to moderate decrease
G3b	30-44	Mild to severe decrease
G4	15-29	Severe decrease
G5	<15	Kidney failure

ALBUMIN EXCRETION RATE (AER)

CATEGORY	AER mg/24 hr	ACR mg/mmol	ACR mg/g	EXPLANATION
A1	<30	<3	<30	Normal to mild increase
A2	30-300	3-30	30-300	Moderate increase
A3	>300	>30	>300	Severe increase

Adapted from KDIGO - Kidney International Supplements (2013) 3, 19-62.

CKD = Chronic Kidney Disease

GFR = Glomerular Filtration Rate (ml/min/1.72m²)

AER= Albumin excretion rate (mg/24 hours)

ACR =Albumin to creatinine ratio (mg/g or mg/mmol) mg/g.

Identify patients in your practice at high risk for Chronic Kidney Disease

- Patients with hypertension
- Patients with diabetes mellitus
- Patients with atherosclerotic coronary, cerebral or peripheral vascular disease
- Patients with heart failure
- Patients with unexplained anemia
- Patients with a family history of end stage renal disease
- First nations peoples

eGFR <30

eGFR 30-60

eGFR >60

Consider reversible factors:

- Medication
- Intercurrent illness
- Volume depletion
- Obstruction

Repeat tests in 2 - 4 weeks

Individualized follow up and treatment

CKD is diagnosed in this group only if other renal abnormalities are present (i.e. proteinuria, hematuria, anatomical)

eGFR <30

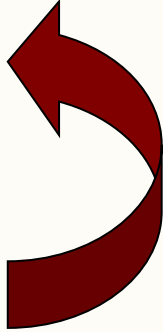
eGFR 30-60

Nephrology referral recommended

Follow eGFR at 3 months then serially
Assess for persistent significant proteinuria
Implement risk reduction

eGFR < 30
 or progressive decline in eGFR
 or persistent significant proteinuria
 or inability to attain treatment targets

Stable eGFR 30-60
 and
 no significant proteinuria






Prevalence

- CKD 4-11% in general population
- Increasing prevalence: awareness, aging population, diabetes prevalence
- Importance : cause and mortality associated with CKD

History/physical

- 
- Vomiting, diarrhea, diuretics, burns, intake/output, Medications (over the counter, homeopathic meds, illicit drugs) radiocontrast dye, trauma, muscle trauma, hypotension, nephrotic syndrome, anticoagulation/thrombolytics,
 - Arthritis, rash, uveitis, weight loss, fatigue, iv drug use, hemoptysis, urinary symptoms, hematuria, history of stones, polyuria
 - Weight, Temperature, orthostatic bp and pulse, mucous membranes, JVP, chest exam, HS, edema,
 - fundoscopic exam, oral ulcers, arthritis, skin lesions, bladder distention, pelvic masses, prostate, peripheral pulses, audible bruits



Causes of CKD

- Diabetes (40%)
- Hypertension (30%)
- Glomerulonephritis
- Tubulointerstitial disease
- Inherited diseases (PKD)



Nutritional assessment

- Change in appetite
- Unintentional weight loss
- Recent surgery/admission in hospital
- Dietary history
- Nausea/vomiting
- Bowel habits
- Chewing/swallowing ability
- Food allergies
- Other comorbid conditions
 - IBD
 - Stroke
 - Cancer
 - Autoimmune disease (ak, lupus, psoriasis)
 - Cirrhosis
 - Cardiac condition
- Weight
- Height
- Subjective global assessment
- Neck circumference
- Abdominal circumference
- Mid arm circumference
- Gait speed
- Time up and go
- Hand grip
- Skin fold calipers
- Bioimpedance
- Dexa
 - Ultrasound muscle assessment
 - Biceps
 - Quadriceps
 - Gastrocnemius

Progression of CKD

Decreased number of nephrons

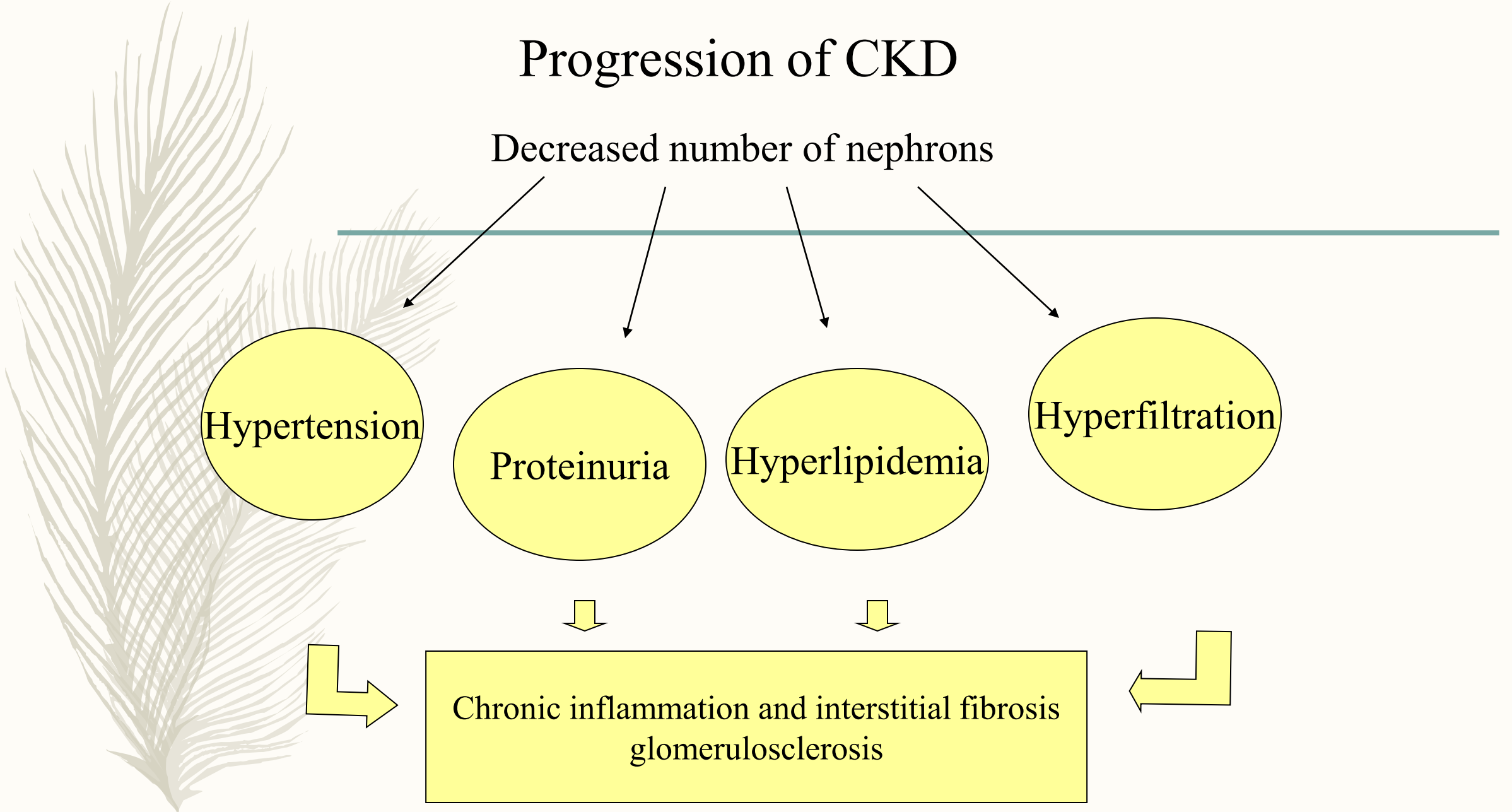
Hypertension

Proteinuria

Hyperlipidemia

Hyperfiltration

Chronic inflammation and interstitial fibrosis
glomerulosclerosis





Management of CKD and Diabetes

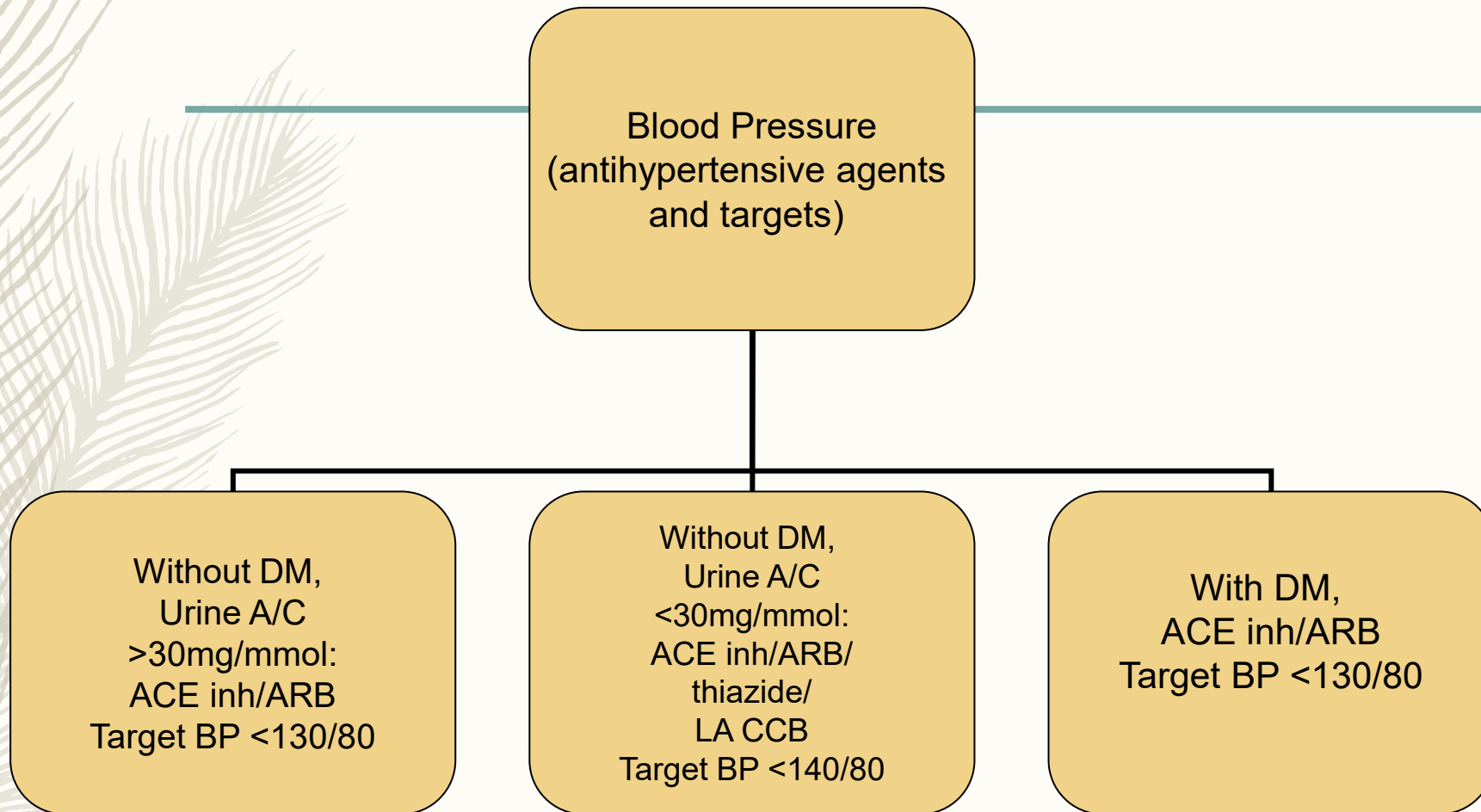
Identification of cause of CKD

Risk factor modification

- Hypertension
- Lipid management
- Diabetes
- Smoking cessation
- Lifestyle modifications
 - Weight management
 - Nutrition (low sodium, low protein, low caloric intake)
- Proteinuria

AKI prevention

KDIGO 2012: CSN commentary



KDIGO 2012: < 140/90 without albuminuria, in diabetics or non-diabetics

Hypertension management

- Proteinuria: RAAS inhibition
- Diabetes: Ace inhibition or ARB
- Cardiovascular disease: beta blockade, calcium channel blockers, mineralocorticoid antagonists
- Renal artery stenosis or Primary hyperaldosteronism: mineralocorticoid antagonists
- Congestive heart failure: diuretics, SACUBITRIL/VALSARTAN, SGLT2 inhibitors, ivabradine



KDIGO 2013

- If age ≥ 50 and has CKD Grade 1-5 not on dialysis, to start statin (check labs at baseline but not to adjust dose to LDL level)
- If age < 50 and has CKD Grade 3a-5 not on dialysis, then to start statin based on one or more of the following:
 - CAD
 - DM
 - Ischemic stroke
 - Estimated 10 year incidence of coronary death or non fatal myocardial infarction $> 10\%$



Lipid management

Used regularly

- Statin/ezetimibe
 - Fibrates

Newer agents

- Pcksk9 inhibitor
- Icosapent ethyl (e-epa)



KDIGO 2012: glycemic control

3.1.15: We recommend a target hemoglobin A1c (HbA1c) of about 7.0% (53mmol/mol) to prevent or delay progression of the microvascular complications of diabetes, including diabetic kidney disease. (1A)

3.1.16: We recommend not treating to an HbA1c target of Below 7.0% in patients at risk of hypoglycemia. (1B)

3.1.17: We suggest that target HbA1c be extended above 7.0% (53mmol/mol) in individuals with comorbidities or limited life expectancy and risk of hypoglycemia. (2C)

3.1.18: In people with CKD and diabetes, glycemic control should be part of a multifactorial intervention strategy

- addressing blood pressure control and cardiovascular risk, promoting the use of angiotensin-converting
- enzyme inhibition or angiotensin receptor blockade, statins, and antiplatelet therapy where clinically indicated. (Not Graded)

Glycemic Control in type 2 diabetes

- Guidelines of the management of CKD state:

“Targets for glycemic control, where they can be achieved safely, should follow the CDA guidelines (Hemoglobin A1c < 7.0%, fasting plasma glucose between 4-7 mmol/L) (grade B)”

- 2008 CDA guidelines added
“A target A1C of <6.5% may be considered in some patients with type 2 diabetes to further lower the risk of nephropathy [*Grade A Level 1A (4)*], but this must be balanced against the risk of hypoglycemia [*Grade A Level 1A (4,5)*] and increased mortality in patients who are at significantly elevated risk of cardiovascular disease [*Grade A Level 1A (4)*]

Management glycemic control

- Type 1 DM
- Insulin pump
- Free style: continuous blood glucose monitoring
- Type of insulin short acting vs long acting
- Pancreas/islet cell transplant
- Type 2 DM
- Metformin
- SGLT2 inhibitors
- Glucagon-like peptide 1 receptor agonist (GLP1 agonist)
 - Liraglutide
 - Semaglutide
- Type of insulin: minimize nocturnal hypoglycemia-glargine/detemir
- Minimize sulfonylurea, DPP4

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.



Bariatric surgery

Advantages

- Glycemic control
- Blood pressure management
- Lipid management
- Prevents progression of renal disease
- Look good/self confidence

Complications

- Gallstones
- Nutritional deficiencies
- Early satiety
- Dumping syndrome
- Kidney stones
- Peptic ulcer disease

Complications

Anemia

Hyperkalemia

Metabolic acidosis

Hyperphosphatemia/hyperparathyroidism

Physical functioning/frailty/cognitive
impairment/mood disorders

Hyperuricemia (cancer risk)

Infections

Cardiovascular disease

Vascular calcification



				Persistent albuminuria categories		
				Description and range		
				A1	A2	A3
				Normal to mildly increased	Moderately increased	Severely increased
				<30 mg/g <3 mg/mmol	30–300 mg/g 3–30 mg/mmol	>300 mg/g >30 mg/mmol
				GFR categories (ml/min/1.73 m ²) Description and range	G1	Normal or high
G2	Mildly decreased	60–89			Monitor	Refer*
G3a	Mildly to moderately decreased	45–59	Monitor		Monitor	Refer
G3b	Moderately to severely decreased	30–44	Monitor		Monitor	Refer
G4	Severely decreased	15–29	Refer*		Refer*	Refer
G5	Kidney failure	<15	Refer		Refer	Refer

Referral decision making by GFR and albuminuria. *Referring clinicians may wish to discuss with their nephrology service depending on local arrangements regarding monitoring or referring.

CHRONIC KIDNEY DISEASE HOW TO TAKE CARE OF MY KIDNEY DISEASE AND DIABETES

My GFR is _____ (GFR = glomerular filtration rate. It is a sign of how well your kidneys are working)



YOUR DIET

- Low sodium diet (less than 1500 mg/day)
- Low potassium diet (less than 2000 mg/day)
- Low phosphate diet (less than 1000 mg/day)
- Low protein diet* (60-120 grams/day)
* depends on body weight)
- Low carbohydrate diet
- Limit fluid intake _____
- or
- Increase fluid intake _____

KEEP YOUR HEMOGLOBIN A1C...

- Less than 7%
- Less than 6.5%
- _____



TAKE YOUR BLOOD SUGAR MEDICATION

- Insulin long-acting
- Insulin short-acting
- Metformin
- SGLT2 Inhibitor (sodium-glucose co-transporter inhibitor)
- GLP-1 receptor agonist



Smoking is harmful for your kidneys. If you smoke, ask your doctor about programs to help you stop smoking.

Check your feet every day and see a foot specialist (podiatrist) to learn how to properly trim your toenails. Have an eye examination every year.

Exercise is important. Ask your doctor how often you should exercise.

KEEP YOUR BLOOD PRESSURE...

- Less than 120/70
- Less than 130/80
- _____ other options



TAKE YOUR KIDNEY PROTECTION MEDICATION

- Angiotensin receptor blocker
- ACE inhibitor
- Mineral corticoid receptor blocker

KEEP YOUR LDL CHOLESTEROL (LOW DENSITY LIPOPROTEIN) UNDER CONTROL (less than 2 mmol/L)



If your cholesterol is not under control, ask if you are taking any of these pills

- | | |
|------------------------------------|----------------------------------|
| <input type="checkbox"/> Statins | <input type="checkbox"/> Lodalys |
| <input type="checkbox"/> Fibrates | <input type="checkbox"/> Repatha |
| <input type="checkbox"/> Ezetimibe | |

COMMENT PRENDRE SOIN DE MA MALADIE RÉNALE ET DE MON DIABÈTE

Mon DFG est de _____ (DFG = débit de filtration glomérulaire. C'est une indication du niveau de fonctionnement de vos reins.)



VOTRE ALIMENTATION

- Alimentation faible en sodium (moins de 1 500 mg/jour)
- Alimentation faible en potassium (moins de 2 000 mg/jour)
- Alimentation faible en phosphore (moins de 1 000 mg/jour)
- Alimentation faible en protéines* (60-120 g/jour)
* dépend de votre poids)
- Alimentation faible en hydrates de carbone
- Limitation de la quantité de liquide _____
- ou
- Augmentation de la quantité de liquide _____

MAINTENIR VOTRE HEMOGLOBINE A1C

- au-dessous de 7%
- au-dessous de 6.5%
- _____



PRENDRE VOS MÉDICAMENTS POUR VOTRE GLYCÉMIE

- Insuline à action prolongée
- Insuline à courte durée d'action
- Metformine
- Inhibiteur SGLT2 (inhibiteur du sodium-glucose co-transporteur)
- GLP-1 agoniste récepteur



Le tabagisme est mauvais pour vos reins. Si vous fumez, informez-vous auprès de votre médecin au sujet des programmes qui peuvent vous aider à arrêter de fumer.

Vérifiez vos pieds tous les jours et voyez un spécialiste des pieds (podiatre) pour apprendre comment couper adéquatement les ongles de vos orteils. Ayez un examen des yeux tous les ans.

Faire une activité physique est important. Demandez à votre médecin à quelle fréquence vous devriez faire de l'exercice.

MAINTENIR VOTRE TENSION ARTÉRIELLE

- au-dessous de 120/70
- au-dessous de 130/80
- _____ autres options



PRENDRE VOS MÉDICAMENTS QUI PROTÈGENT VOS REINS

- Antagonistes des récepteurs de l'angiotensine
- Inhibiteurs de l'ECA
- Antagonistes de récepteurs des minéralocorticoïdes

GARDER VOTRE CHOLESTÉROL LDL (LIPOPROTEINES DE FAIBLE DENSITÉ) SOUS CONTRÔLE (moins de 2 mmol/L)



Si votre cholestérol n'est pas sous contrôle, demandez si vous prenez un de ces médicaments

- | | |
|------------------------------------|----------------------------------|
| <input type="checkbox"/> Statines | <input type="checkbox"/> Lodalys |
| <input type="checkbox"/> Fibrates | <input type="checkbox"/> Repatha |
| <input type="checkbox"/> Ezétimibe | |



Low osmolar diet

- Low sodium: 1500mg/day to 2000mg/day (65mmol/day-90mmol/day)
- Low protein: 0.8g/kg/IBW day plus losses
- Energy intake 30-35kcal/kg/IBW

- Low potassium intake if hyperkalemia (60-80mmol/day)
- Low phosphate 800 -1000mg / day (26-32mmo/day)
 - Organic and non-organic



My version

- Graph the eGFR
 - Steady/stable
 - Fluctuating eGFR
 - Decline at rate less than 2ml/min/year or greater
 - Step wise decline
- Urinalysis is crucial
- Imaging the kidney (point of care ultrasound)

Approach by age

- More diabetes and vascular disease
- Debate of aging glomerulosclerosis versus renal disease
- Due to age, more comorbidities associated with AKI



Diabetes status

- Insulin resistance vs insulin depletion
- Obesity-metabolic syndrome-prediabetes-diabetes
- Hyperuricemia
- Glycemic control
- Second hit





CKD obstructive uropathy/neurogenic bladder/reflux

- Hydronephrosis, single vs bilateral
- Use of ace inhibitor/arb/diuretics avoid
- Preserve renal function by minimizing infections

CKD with renal artery stenosis

- Elderly/ hypertensive
- Young black women (fibromuscular dysplasia)
- Avoid ace inhibition
- MRA seem to be more effective from clinical experience





CKD (cardiorenal)

- 1. Acute heart failure to AKI
- 2. Chronic heart failure to CKD
- 3. AKI leading to pulmonary edema
- 4. CKD leading to CHF
- 5. other causes leading to both e.g. amyloidosis, cirrhosis, sepsis
- [Cardiorenal Syndrome: Classification, Pathophysiology, Diagnosis, and Treatment Strategies: A Scientific Statement From the American Heart Association](#)
- Janani Rangaswami, MD, Vice Chair Vivek Bhalla, MD, FAHA John E.A. Blair, MD Tara I. Chang, MD, MS Salvatore Costa, MD Krista L. Lentine, MD, PhD Edgar V. Lerma, MD, FAHA Kenechukwu Mezue, MD, MSc Mark Molitch, MD Wilfried Mullens, MD, PhD Claudio Ronco, MD W.H. Wilson Tang, MD, FAHA Peter A. McCullough, MD, MPH, FAHA, Chair On behalf of the American Heart Association Council on the Kidney in Cardiovascular Disease and Council on Clinical Cardiology



CKD in cancer

- Multiple injuries to the kidney
 - AKI from tumor lysis, contrast nephropathy, nephrotoxic drugs
 - Hyperuricemia
 - ATN from volume depletion
 - Hypercalcemia
 - Recurrent infections
 - Obstructive uropathy
 - Glomerular diseases



AKI prevention

- Avoid nephrotoxic drugs, e.g. NSAIDs, Aminoglycosides, etc.
- Review new medication with pharmacist/physician
- Avoid radiocontrast dye
- Promotes vaccinations
- Seek medical help if develop gastrointestinal symptoms immediately
- Stop drugs such as RAAS blockade, tolvaptan, diuretics if develop symptoms that can lead to volume depletion
- Maintain hydration during exercise



Models of care with family physician

- Transfer of care to a multidisciplinary clinic
- Change care to shared care
- Family physician takes care after one consultation with nephrologist and ongoing contact
- Focus on self empowerment



CKD summary

- Conventional definition, diagnosis, management and follow up
- CKD diagnosis by clinical presentation, urinalysis and kidney imaging
- Management by comorbidity