Chronic Kidney Disease: Epidemiology, Definitions, and Monitoring

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Chronic kidney disease

- Epidemiology and public health impact
- Definitions of chronic kidney disease
  - Assessing degree of chronic kidney disease
  - Staging chronic kidney disease
- Screening for chronic kidney disease
- Progression of chronic kidney disease
  - Causes of progression
  - Monitoring for progression
- Treatment of chronic kidney disease
  - Slowing progression
  - Managing chronic kidney disease complications

Chronic kidney disease epidemiology

- Chronic kidney disease (CKD) is a major public health issue
- Approximately 19 million adults in the US have CKD
- CKD care account for almost 15% of Medicare expenses
- Approximately 600,000 have end-stage renal disease (ESRD)
- In the UK, 2%of all National Health Service expenses go towards ESRD care
- By 2030, it is estimated that 2 million people will have ESRD in the US

Chronic kidney disease (CKD) definitions

From the National Kidney Foundation:

The presence of markers of kidney damage for ≥3 months, as defined by structural or functional abnormalities of the kidney with or without decreased glomerular filtration rate (GFR), that can lead to decreased GFR, manifest by either pathological abnormalities or other markers of kidney damage, including abnormalities in the composition of blood or urine (i.e. proteinuria), or abnormalities in imaging tests

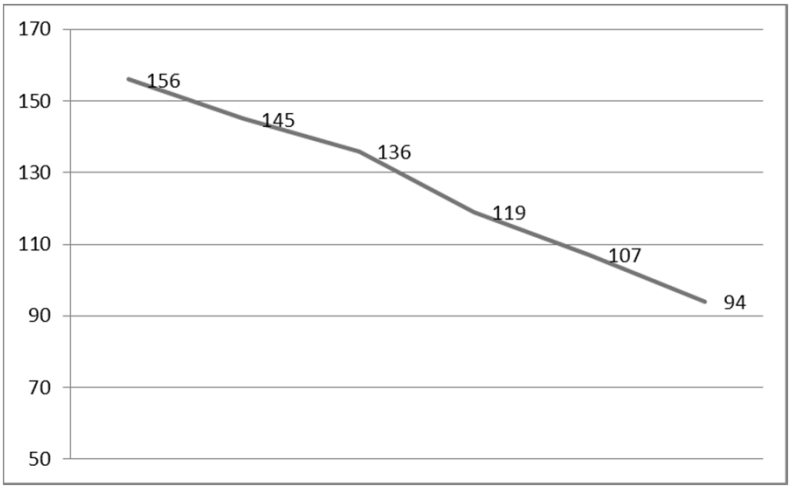
OR

The presence of GFR <60 mL/min/1.73 m2 for ≥3 months, with or without other signs of kidney damage as described above.

Assessing degree of chronic kidney disease

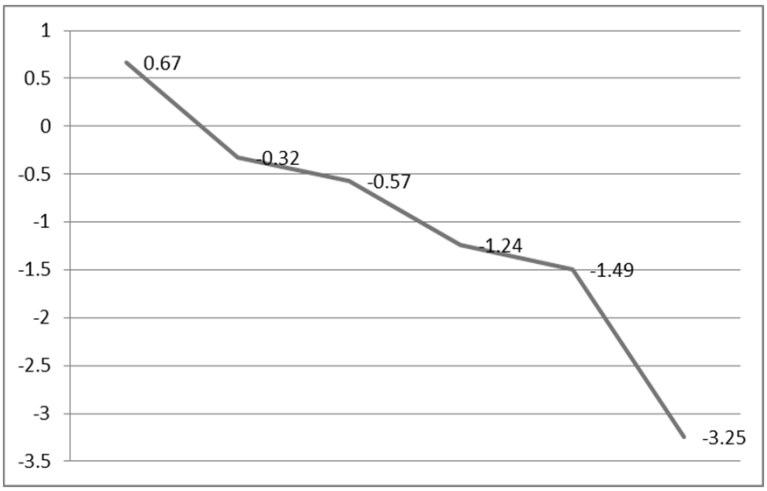
- **Kidney disease is best represented by the glomerular filtration rate (GFR)**
- **Normal values for GFR are approximately 130cc/min/1.73m2 for young men and 130 cc/min/1.73m2 for your women**
- **Severity of CKD is primarily based on the GFR**

Normal values of GFR



Creatinine clearance (cc/min) by decade from 30yo to 90yo

Normal values of GFR



Slope of creatinine clearance (cc/min/yr) by decade from 30yo to 90yo

Assessing GFR: Estimating equations for GFR

- **For clinical utility, biological markers (creatinine mainly) need to be converted into estimates of GFR (eGFR)**
- **A number of equations have been developed**
  - **Cockroft-Gault**
  - **MDRD**
  - **CKD – EPI**
- **Modifications of these equations have been developed that use both serum creatinine and cystatin C**

Why use eGFR Instead of SCr for Kidney Function?

Age	Gender	Race	SCr (mg/dL)	eGFR (mL/min/1.73 m^2)	CKD Stage
20	M	B*	**1.3**	91	**1**
20	M	W†	**1.3**	75	**2**
55	M	W	**1.3**	61	**2**
20	F	W	**1.3**	56	**3**
55	F	B	**1.3**	55	**3**
50	F	W	**1.3**	46	**3**

***B = black; †W = all ethnic groups other than black.**

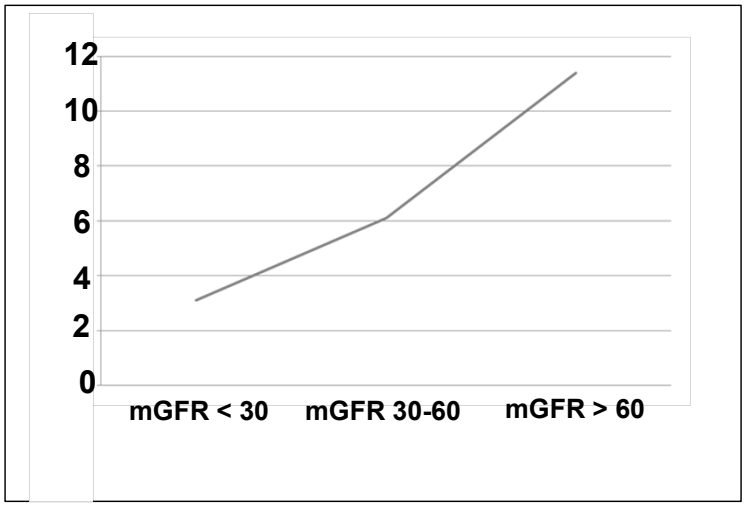
GFR calculator available at: www.kidney.org/index.cfm?index=professionals. Accessed 3/28/05.

Variability of eGFR independent of kidney function

- **Serial Serum Creatinine (Scr)**
  - **Change in Scr without change in GFR**
    - **Increased creatinine production**
      - **Eating cooked meat, creatine ingestion**
      - **Increasing muscle mass**
      - **Fenofibrate therapy**
    - **Decreased Creatinine production**
      - **Vegetarian diet**
      - **Muscle wasting**
    - **Decreased tubular secretion of creatinine**
      - **Cimetidine**
      - **Triamterene**
- **eGFR by MDRD or CKD-EPI formula - GFR > 60 Limitations**
  - **Overestimates actual GFR in those with low creatinine production**
  - **Underestimates actual GFR in those with high creatinine production**

Variability of eGFR independent of kidney function

Difference between eGFR by MDRD and eGFR by C-G



Variability in CKD staging based on eGFR equation

- **Reclassification of CKD Stage by MDRD when using CKD-EPI**

CKD Stage by MDRD	% Reclassified 1 stage using CKD-EPI
90 cc/min	1.2% downward
60-89	34.3% upward, 0.2% downward
45-59	34.7% upward, 1.2% downward
30-44	13.7% upward, 2.1% downward
15-29	4.8% upward

Staging of chronic kidney disease

Table 1. Stages of Chronic Kidney Disease (CKD), Prevalence in the United States in 2000, and Stage-Specific Recommendations for Detection, Evaluation, and Management.

Stage Of CKD	Description	GFR	Detection, Evaluation, and Management*		Prevalence†
				%	% No. of Cases (95% CI)
		ml/min/1.73 m2			*millions*
1	Kidney damage with normal or increased GFR	>90	Diagnosis and treatment Treatment of coexisting conditions Slowing progression Risk reduction for cardiovascular disease	2.8	5.6 (4.0–7.2)
2	Kidney damage with mild decrease in GFR	60–89	Estimation of progression	2.8	5.7 (4.2–7.2)
3	Moderate decrease in GFR	30–59	Evaluation and treatment of complications	3.7	7.4 (6.0–8.9)
4	Severe decrease in GFR	15–29	Referral to nephrologist and consideration for kidney replacement therapy	0.1	0.30 (0.02–0.5)
5	Kidney failure	<15	Replacement (if uremia present)	0.2	0.30‡

* The importance of the GFR is cumulative in that recommended care at each stage of CKD includes care for less severe stages. Adapted from the Kidney Disease Outcome Quality Initiative of the National Kidney Foundation.2

† Kidney damage is defined as persistent albuminuria on two occasions. Estimates are similar to those from the Third National Health and Nutrition Evaluation Survey (1988 to 1994), which are derived from a larger number of subjects and are therefore more precise.13 CI denotes confidence interval.

‡ Data on the prevalence of stage 5 are from the U.S. Renal Data System for the number of patients receiving dialysis therapy. This value is an underestimate, since it does not include the additional unknown number with kidney failure who are not receiving treatment.2,14

Stevens LA et al. N Engl J Med 2006;354:2473-2483

Staging of chronic kidney disease

Table 2. Adjusted Hazard Ratio for Death from Any Cause, Cardiovascular Events, and Hospitalization among 1,120,295 Ambulatory Adults, According to the Estimated GFR.*

Estimated GFR	Death from Any Cause	Any Cardiovascular Event	Any Hospitalization
	adjusted hazard ratio (95 percent confidence interval)		
≥60 ml/min/1.73 m^2†	1.00	1.00	1.00
45–59 ml/min/1.73 m^2	1.2 (1.1–1.2)	1.4 (1.4–1.5)	1.1 (1.1–1.1)
30–44 ml/min/1.73 m^2	1.8 (1.7–1.9)	2.0 (1.9–2.1)	1.5 (1.5–1.5)
15–29 ml/min/1.73 m^2	3.2 (3.1–3.4)	2.8 (2.6–2.9)	2.1 (2.0–2.2)
<15 ml/min/1.73 m^2	5.9 (5.4–6.5)	3.4 (3.1–3.8)	3.1 (3.0–3.3)

* The analyses were adjusted for age, sex, income, education, use or nonuse of dialysis, and the presence or absence of prior coronary heart disease, prior chronic heart failure, prior ischemic stroke or transient ischemic attack, prior peripheral arterial disease, diabetes mellitus, hypertension, dyslipidemia, cancer, a serum albumin level of 3.5 g per deciliter or less, dementia, cirrhosis or chronic liver disease, chronic lung disease, documented proteinuria, and prior hospitalizations.

† This group served as the reference group.

Go AS et al. NEJM 2004: 351: 1296-1305

Staging of chronic kidney disease

Stage 1 disease is defined by a normal GFR (greater than 90 mL/min per 1.73 m2) and persistent albuminuria

Stage 2 disease is a GFR between 60 to 89 mL/min per 1.73 m2 and persistent albuminuria

Stage 3a disease is a GFR between 45 and 59 mL/min per 1.73 m2
Stage 3b disease is a GFR between 30 and 44 mL/min per 1.73 m2

Stage 4 disease is a GFR between 15 and 29 mL/min per 1.73 m2

Stage 5 disease is a GFR of less than 15 mL/min per 1.73 m2 or end-stage renal disease

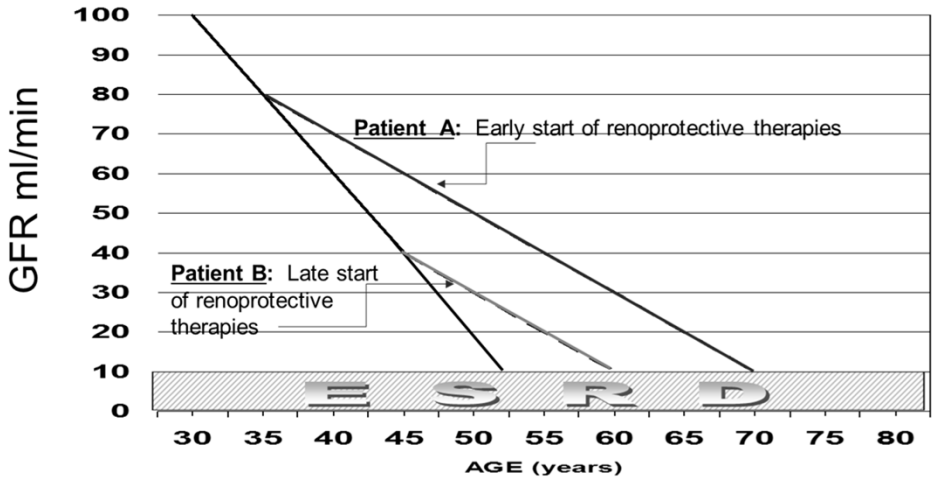
CKD Screening

- **Elderly (> 65yo)**
- **Hypertension**
- **Diabetes mellitus**
- **Urologic disease: recurrent infections, stone disease**
- **Autoimmune conditions**
- **History of nephrotoxic drugs**
- **Family history of CKD**
- **Other potential subjects**
  - **Smokers, obesity / metabolic syndrome, reduced renal mass, previous acute kidney injury**

Screening tests to detect CKD

- Blood pressure
- Urinalysis
- Urine albumin or protein quantification
- Serum creatinine with estimated GFR

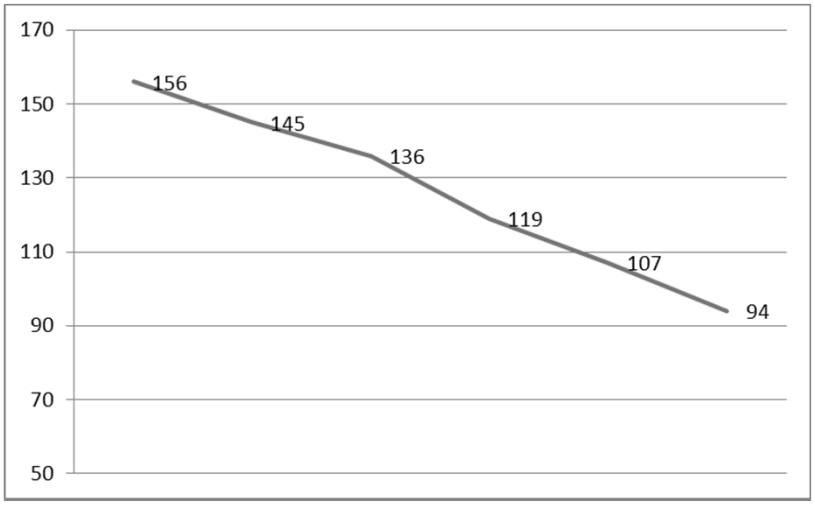
Progression of CKD



Progression of CKD

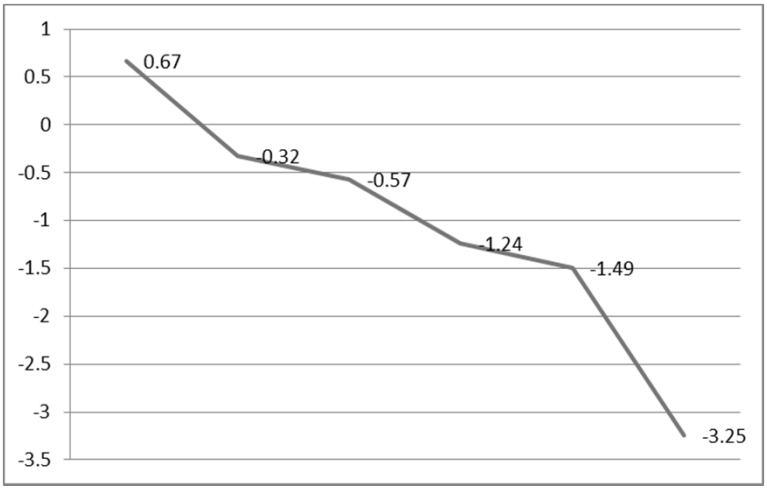
- Factors involved in the linear decline of GFR
  - Primary renal disease is still active
  - Nephropathy of aging
    - Typically lacks proteinuria
    - Diagnosis of exclusion
  - Natural progression
    - Nephron loss (usually >50%) leads to hyperfiltration
    - Typically associated with worsening proteinuria
    - Remainder
    - Diagnosis of exclusion

Nephropathy of aging



Creatinine clearance by decade from 30yo to 90yo

Nephropathy of aging



Slope of creatinine clearance by decade from 30yo to 90yo

Monitoring for progression: Proteinuria

- **Approximate time to doubling of serum creatinine or ESRD stratified by proteinuria**

10% of population reaching outcome:

< 1gm/24 hours	**21 months**
1-3gm/24 hours	**13 months**
> 3gm/24 hours	**9 months**

25% of population reaching outcome:

< 1gm/24 hours	**>36 months**
1-3gm/24 hours	**24 months**
> 3gm/24 hours	**18 months**

Implications of proteinuria

- **Even with normal GFR levels, proteinuria is associated with significant adverse events**

Cardiovascular mortality:
eGFR > 105 with ACR <10 – Relative risk (RR) 1.0
eGFR > 105 with ACR 30-300 – RR 2.3
eGFR > 105 with ACR > 300 – RR 2.1

End stage renal disease:
eGFR > 105 with ACR <10 – Relative risk (RR) 1.0
eGFR > 105 with ACR 30-300 – RR 7.8
eGFR > 105 with ACR > 300 – RR 18

Monitoring for progression: Proteinuria

- **Proteinuria is the strongest predictor of progressive decline in GFR**
- **Quantification of proteinuria is important**
- **Albuminuria or proteinuria**
  - **If the total proteinuria is < 500mg/day, then urine albumin to creatinine ratio (ACR) is best for detecting early progression**
  - **If the total proteinuria is > 500mg/day, then proteinuria and albuminuria are parallel, so either ACR or urine protein to creatinine ratio (PCR) can be utilized**

Staging of chronic kidney disease – GA Staging

- G Staging
- Stage 1: disease is defined by a normal GFR (greater than 90 mL/min per 1.73 m2) and persistent albuminuria
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- Stage 3a: disease is a GFR between 45 and 59 mL/min per 1.73 m2
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- A Staging
- Stage A1: Albuminuria < 30mg/gm creatinine
- Stage A2: Albuminuria 30-300mg/gm creatinine
- Stage A3: Albuminuria > 300mg/gm creatinine

Risk factors for progression

- Age
- Race
- Smoking
- Hypertension
- Diabetes mellitus
- Cardiovascular disease
- Albuminuria
- Hyperuricemia
- Nephrotoxin exposure
- Dyslipidemia

- Therapy for progression and CKD management – Dr. Shidham

Management of CKD

Ganesh Shidham, MD

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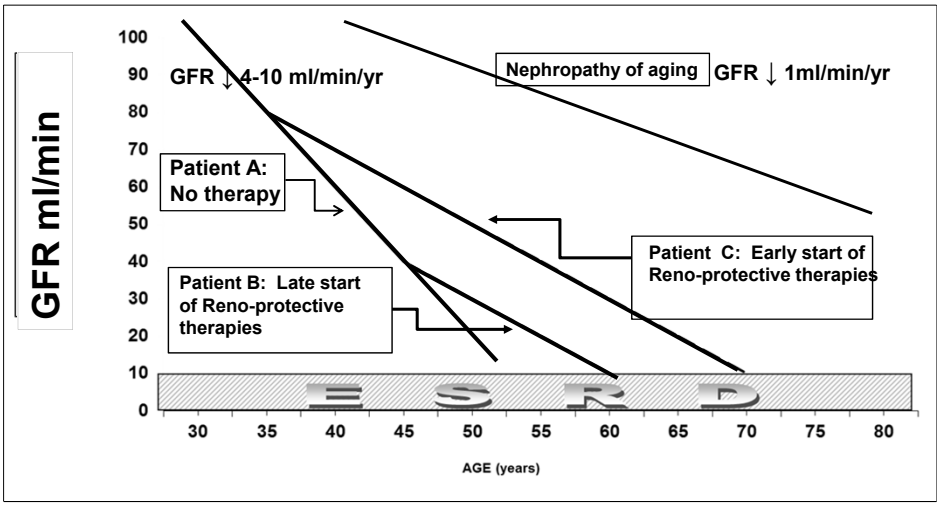
Division of Nephrology
The Ohio State University Wexner Medical Center

Management of CKD-Outline

- **Progressive Renal disease and timing of intervention**
- **Monitoring Kidney disease progression**
- **Kidney Protective therapies**
  - **Level 1 Recommendations**
  - **Level 2 Recommendations**
- **Treatment of Complications of CKD**
- **Advanced CKD Management –Preparing for RRT**
- **Water Intake in CKD**
- **Risk of Infection/Vaccine**
- **Nephrology referral**

Progressive renal disease



Kidney Protective Therapies

- **Principal Target:**
  - **Treatment of underlying disease**
  - **Attain BP goal**
  - **Attain Proteinuria goal**
- **Goal:**
  - **Reduce proteinuria to < 500 mg/day**
  - **Slow GFR decline to 1ml/min/yr**

Kidney Protective therapies:

Level 1 Recommendations (Goal: Implement all)

1. Control blood pressure
2. Administer ACE-I, ARB, or renin inhibitor.
3. Avoid Dihydropyridine CCB in presence of proteinuria (unless needed for BP)
4. Control protein intake.

Kidney Protective therapies:

Level 2 Recommendations (Implement as many as possible)

1. Restrict NaCl intake.
2. Administer NDHP-CCB therapy.
3. Control metabolic syndrome.
4. Aldosterone antagonist therapy.
5. Allopurinol therapy.
6. Control serum phosphorous.
7. Smoking cessation.
8. Perform alkali therapy.
9. β-blocker therapy.
10. Avoid over anticoagulation with warfarin.

1. Hypertension

The Second Leading cause of Kidney Failure

BP Control: Bang for the Buck

Hypertension Goals

	JNC 8	KDIGO	ESH/ESC 2013 Guidelines	ASH/ISH Statement
In General	≥ 60 yrs: <150/90 < 60 yrs: < 140/90		<140/90	<140/90
Exception or special comment	Diabetes < 140/90 **CKD** **< 140/90**	**CKD:** • **No Proteinuria <140/90** • **With Proteinuria <130/80** • Kidney Tx <130/80 • Elderly <140/90 or higher (depending on comorbidities)	Elderly > 80 yrs < 150/90 Elderly < 80 yrs < 150/90 Fit elderly < 140/90 Diabetes < 140/85 **CKD+Proteinuria** **< 130/90**	< 80 yrs < 150/90 **CKD + Proteinuria** **< 130/80**

Hypertension Goals

	JNC 8	KDIGO	ESH/ESC 2013 Guidelines	ASH/ISH Statement
In General	≥ 60 yrs: <150/90 < 60 yrs: < 140/90		<140/90	<140/90
Exception or special comment	Diabetes < 140/90 **CKD** **< 140/90**	**CKD:** • **No Proteinuria <140/90** • **With Proteinuria <130/80** • Kidney Tx <130/80 • Elderly <140/90 or higher (depending on comorbidities)	Elderly > 80 yrs < 150/90 Elderly < 80 yrs < 150/90 Fit elderly < 140/90 Diabetes < 140/85 **CKD+Proteinuria** **< 130/90**	< 80 yrs < 150/90 **CKD + Proteinuria** **< 130/80**

Antihypertensive Therapy Algorithm in CKD

	+ Proteinuria		No Proteinuria	
	+ Edema	No Edema	+Edema	No Edema
First Line Therapy	ACE-I/ARB	ACE-I/ARB	ACE-I/ARB	ACE-I/ARB
Second Line Therapy	Diuretics	NDHP CCB Verapamil, Cardizem	Diuretics	DHP CCB Amlodipine, Nifedipine
Third Line Therapy	NDHP CCB	xxxx	DHP CCB	xxxx
Fourth Line Therapy	Spironolactone, Eplerenone	Spironolactone, Eplerenone	Spironolactone, Eplerenone	Spironolactone, Eplerenone
Beta Blocker (Carvedilol) : Added at any step if indicated for Cardiac disease. Avoid combining with NDHP CCP				
Other Meds for BP control : Add DHP to NDHP CCB, Add NDHP to DHP CCB, Minoxidil, Doxazosin, Hydralazine				

Antihypertensive therapy - cont

If BP still high, suggest following:

- **Is HBPM accurate- ABPM**
- **Medication compliance**
- **Excessive salt intake**
- **OTC meds- decongestants, NSAIDs– cocaine, Licorice, alcohol**
- **Sleep apnea**
- **Rule out secondary etiologies**

RAS Blockade

- **RAS blockage recommended even if hypertension is not present**
- **Greater the ACE inhibitor or ARB dose, the greater the effect on control of hypertension and proteinuria**
- **Continued even if GFR declines to stage 4 CKD**
- **Significantly more effective in slowing GFR decline in the obese than in the non-obese**
- **Combination therapy (ACE-I plus ARB)**
  - **Not recommended, particularly in elderly**
  - **Possible role in non-elderly with heavy proteinuria**

Nephrology (Carlton). 15 (suppl 2):57-60, 2010
J Am Soc Nephrol. 22:1122-1128, 2011

Blood Pressure control

- Systolic BP is recommended target. It correlates better with CKD progression
- To restore nocturnal BP dip, administer at least 1 BP med at night
- May take several years for the benefit to be shown
- Important to achieve BP goal sooner rather than later
- Greater the proteinuria, more the benefit of low BP goal
- Whenever possible - HBPM preferred over clinic BP.

Am Soc Nephrol. 4:830-837,2009
Arch Intern Med. 168:832-839,2008
Arch Intern Med.171:1090-1098,2011
Am J Kid Dis. 2007 Dec;50(6):908-17

2. Diabetes

The Leading Cause of Kidney Failure

Effects of Good Glycemic Control on Complications, Including Nephropathy

	Trial		
Complication	**DCCT A1C: (9 → 7%) N = 1441**	**Kumamoto (9 → 7%) N = 110**	**UKPDS (8 → 7%) N = 5102**
Retinopathy	↓ 76%	↓ 69%	↓ 17-21%
Nephropathy	↓ 54%	↓ 70%	↓ 24-33%
Neuropathy	↓ 60%	–	–

DCCT = The Diabetes Control and Complications Trial.
DCCT Study Group. *N Engl J Med*. 1993;329:977-986; Ohkubo. *Diabetes Res Clin Prac*. 1995;28:103-117; UKPDS Study Group. *Lancet*. 1998;352:837-853.

3. Control Protein intake

- **Normal protein intake 1-1.5 gm/kg/day**
- **Goal: 0.8 gm/kg/day (KDIGO rec)**
  - **Slows GFR decline**
  - **Decreases proteinuria**
- **Monitor dietary protein by checking 24 hr Urine Urea Nitrogen (UUN)**
- **Dietary protein in gm/day~ 24 hr UUN in gm x 6.25**
- **Reduction in protein from Red Meat**
- **Encourage vegetable protein (Soy)**

4. Restrict Salt intake

- **Low salt intake Recommended:**
  - **2 gm Na/day = 80-85 mmol Na =5 gm NaCl**
- **High salt intake**
  - **200 mmol/day Na = 4.6 gm Na =11.6 gm NaCl**
  - **Overrides anti-proteinuric effects of ARB, ACE-I or NDHP-CCB**
  - **Worsens Hypertension**
  - **Predicts rapid GFR decline**

J Am Soc Nephrol.23:165-173, 2012

5. Control Metabolic syndrome

- **Obesity – associated with Glomerulopathy, FSGS, and proteinuria**
- **Moderate reduction in obesity can reduce proteinuria**
- **Healthy Lifestyle, weight reduction and diet**

Management of Cardiovascular risk:

- **Antiplatelet agent**
- **Statin for all CKD patients >50 yrs regardless of lipid levels (Atorvastatin 20 mg qd)**

KDIGO Dyslipidemia work gr: Kidney Int Suppl. 3:263, 2013

6. Smoking cessation

- Smoking associated with
  - Increases glomerular hyper-filtration and proteinuria
  - Glomerulopathy similar to Diabetic Nephropathy
  - Nephrosclerosis
- Smoking cessation –associated with slower progression of CKD

J Am Soc Nephrol. 2004;15 Suppl 1:S58

7. Allopurinol/Febuxostat

- Allopurinol/Febuxostat
  - Slows CKD progression
  - Anti-inflammatory and cardioprotective
- Uric acid:
  - Pro-inflammatory and vasculotoxic
- Goal: Uric acid < 7 mg/dl

Gibson T, Rodgers V, Potter C, Simmonds HA: *Ann Rheum Dis.* 41:59-65 1982

8. Correct Vit D Deficiency

- Common in CKD
- Associated with
  - CVD risk
  - Infection
  - Thrombotic disease
  - Progression of CKD
- Can cause Secondary Hyperparathyroidism
- Treatment: Vit D 3 1000-2000 Units q day or 50K units q week for 8 weeks and then monthly for 6 months.

J Am Soc Nephrol. 22:994-998 2011

9. Avoid Over-anticoagulation with Warfarin

- INR > 3, predisposes to Warfarin Related Nephropathy (WRN)
- WRN common in CKD
- AKI improves, however rate of CKD progression is increased

Kidney Int. 80:181-189 2011

10. Drugs to Avoid in AKI or CKD

- NSAIDS
- COX 2 inhibitors
- Metformin (lactic acidosis).
- Gentamicin, Tobramycin
- Demerol, Darvon
- Reduce morphine dose 50-75% for GFR<50

11.Dose Reductions for CKD

- Statins – use only starting dose
- Neurontin – do not exceed 900 mg daily
- Reglan – limit to 5 mg TID
- Cipro – use 50-75% usual dose when GFR 10-50
- Atenolol, nadolol, bisoprolol – use 50% usual dose

Treatment of Complications of CKD

Treatment of Complications of CKD

Metabolic acidosis
Hyperphosphatemia
Hyperparathyroidism
Anemia
Hyperkalemia
Volume overload

12. Metabolic Acidosis: Alkali Therapy

- **Metabolic Acidosis:**
  - **Aggravates hyperkalemia**
  - **Inhibits protein anabolism**
  - **Accelerates calcium loss from bone**
- **Alkali Therapy:**
  - **Slows CKD progression by:**
    - **Blocking endothelin production**
    - **Suppresses alternate complement pathway**
    - **Reduces Oxidative damage**
- **Goal: Bicarb > 22 mmol/dl**

Am J Kidney Dis. 29:291-302, 1997
J Am Soc Nephrol. 20:2075-2084, 2009

13. Hyperphosphatemia: Phosphorus control

- **CKD stage 3-4, Goal P 2.6-4.5 mg/dl**
- **CKD stage 5, Goal P 3.5-5.5 mg/dl**
- **Low P diet: Substitute Meat and diary products with grains.**
- **P binders**
  - **Ca Acetate(Phoslo), Ca Carbonate(Tums), Sevalamer (Renvela), Lanthinum Carbonate (Fosrenol), Velphoro (Iron based)**

KDIGO recommendation 3

14. Secondary Hyperparathyroidism

CKD Stage	Target iPTH (pg/ml)
3	35-70
4	70-110
5	150-300

14. Secondary Hyperparathyroidism

- **If iPTH elevated and 25 OH vit D normal: Treat with calcitriol or paricalcitol**
- **Calcitriol directly suppresses PTH release**
- **Follow iPTH, Ca, Phos every 3 months**

15. Anemia

- Recombinant human EPO is available
  - Procrit, Darbepoetin (Aranesp), Epogen, Mircera
- Target Hg 10-11gm/dl
- Treatment of anemia in CKD is associated with:
  - Regression of LVH
  - Delayed progression of CKD
  - Improved quality of life
  - Decrease in transfusion

KDIGO Anemia recommendations: Kidney Int Suppl. 2:279-335 2012

Advanced CKD (Stage 4-5) Management

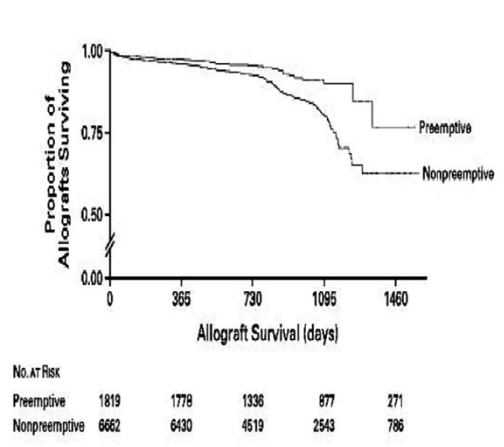
Preparing for Renal Replacement Therapy

Advanced CKD (Stage 4-5) - management

- Educate about various Renal Replacement therapies
- No blood draws from non-dominant arm
- Avoid PICC lines
- Get Upper Extremity Venous mapping before getting AV Fistula or Graft
- AVF takes > 6-8 weeks to mature
- AVG – Can be used in 3 weeks
- Peritoneal Catheter – 3 weeks
- Refer for Transplant evaluation (Can be referred when GFR is < 20 ml/min)

CKD - Transplantation

Preemptive transplant carries both patient and graft survival advantage.



Water intake in CKD

- **Studies supporting high water intake:**
  - **Urine Osmolarity and Risk of Dialysis Initiation in a Chronic Kidney Disease Cohort – a Possible Titration Target? PLoS ONE (2014) 9(3): e93226. doi:10.1371/journal.pone.0093226**
- **Studies opposing high water intake:**
  - **High Urine Volume and Low Urine Osmolality Are Risk Factors for Faster Progression of Renal Disease. American Journal of Kidney Diseases, Vol 41, No 5 (May), 2003: pp 962-97**
- **Our practice:**
  - **Drink water to thirst**
  - **Not to overdo**
  - **Prevent dehydration**

CKD: Risk of Infection

- **Annual Influenza vaccine (all CKD)**
- **< 30 GFR:**
  - **Polyvalent Pneumococcal Vaccine (every 5 yrs)**
  - **Hepatitis B vaccine**

Referral to Nephrology in patient with CKD

- GFR <30 ml/min
- GFR > 30 ml/min
  - Sustained GFR decline of >5 ml/min in 1 year
  - >25% drop in GFR from baseline
  - Urine alb/creat ratio (ACR) ≥300 mg/g
  - Sustained Hematuria >20RBC/HPF or Cast
  - K > 5.5 meq/L
  - Resistant hypertension
  - Recurrent or extensive nephrolithiasis
  - Hereditary kidney disease

Management of CKD: Summary

1. Implement as many Reno-protective measures as possible to reach goal GFR of 1 ml/min/yr and Proteinuria of < 500 mg/day.
2. Progressive renal disease – GFR decline is usually 4-10 ml/min/yr.
3. BP control: Bang for the Buck.
4. ACE-I/ARB – first line of therapy.
5. Reno-protective measures should be started early in course of Renal disease.
6. Refer Nephrology when appropriate
7. Multiple simple therapies can improve kidney disease progression