

Challenges and Controversies in Geriatric Medicine

Chronic Kidney

Disease in

Older Adults

Diagnosis and

Management

Guidelines for the

Primary Physician

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Challenges and Controversies in Geriatric Medicine

Chronic Kidney Disease (CKD) in Older Adults

GOAL

To review current guidelines for the diagnosis and treatment of Chronic Kidney Disease in the elderly patient.

TARGET AUDIENCE

This review is written with the primary care physician in mind.

LEARNING OBJECTIVES

By the end of this digest, participants will have proficiency to:

- Increase the rate of identification of patients with occult but progressive chronic kidney disease.
- Increase provider awareness of patients who may have occult kidney disease by advising them of patient's GFR.
- Cross reference patients with chronic kidney disease with medication use to identify patients receiving medications requiring dosage adjustment.
- Increase patient awareness of chronic kidney disease and necessary lifestyle adjustments.
- Decrease progression of kidney disease to greatest extent possible.
- Identify and treat complications from kidney disease per se.
- Identify and treat complications from co-morbid conditions.
- Refer patients to nephrologists in a timely fashion.

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Russell E. Brower, MD, MBA

Dr. Brower is currently Vice President and Medical Director for SCAN Health Plan® where he is the Chair of Peer Review Committee, Credentialing Committee and the Pharmacy and Therapeutics Committee. Dr. Brower has worked at SCAN since 1999.

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Dr. Brower went on to complete his Masters Degree in Business Administration at Pepperdine University in 2000.

Allen R. Nissenson, MD, FACP

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Dr. Nissenson has served as Chair of the Southern California End-Stage Renal Disease (ESRD) Network during its organizational years in the early 1980s, and is now serving as President. He has long been involved in issues of health care delivery, and has consulted for the Rand Corporation and PacifiCare on the development of capitation models for ESRD used in a seminal HCFA Demonstration Project in this area.

Dr. Nissenson served as a Robert Wood Johnson Health Policy Fellow of the Institute of Medicine in 1994–1995, working in the office of the late Senator Paul Wellstone. He has served as President of the Renal Physicians Association, the national organization of nephrologists concerned with socioeconomic and clinical practice issues in nephrology, and remains on the Board of Directors as Special Advisor to the President. He has served as a member of the Advisory Group overseeing the entire Dialysis Outcomes Quality Initiative of the National Kidney Foundation (NKF-DOQI), as well as serving as a member of the anemia work group.

Dr. Nissenson is the author of two dialysis textbooks, both in their fourth editions and was the founding Editor-in-Chief of *Advances in Renal Replacement Therapy*, an official journal of the National Kidney Foundation. He is currently Editor-in-Chief of *Hemodialysis International* the official journal of the International Society for Hemodialysis, as well as *Medscape Nephrology*, an innovative website focused on nephrology. He has over 450 publications in the field of nephrology, dialysis, anemia management, and health care delivery and policy. Among his numerous honors is the President's Award of the National Kidney Foundation. In 2007 he was the recipient of the Lifetime Achievement Award in Hemodialysis presented by the University of Missouri on behalf of the Annual Dialysis Conference.

Overview, Diagnosis, and Staging

Kidney disease is defined by the National Kidney Foundation by abnormalities on kidney biopsy or renal imaging studies; abnormal urinalysis; and/or a decrease in glomerular filtration rate (GFR). The clinical evaluation of patients at increased risk for chronic kidney disease (CKD) includes measurement of blood pressure, examination of urine sediment, measurement of protein-to-creatinine ratio in a spot urine sample, and measurement of GFR, calculated from the serum creatinine. Although the elderly are an at-risk population, these evaluations are infrequently performed, and even when they are they are often misinterpreted. Only a fraction of Medicare beneficiaries undergo a screening urinalysis or serum creatinine. Even when the latter is obtained, values that appear “normal” may in fact indicate significant kidney disease in the frail elderly.

To overcome the shortcomings of the serum creatinine measurement, a calculated GFR is used. This calculation utilizes a formula developed as part of the Modification of Diet in Kidney Disease (MDRD) study, funded by the NIH:

$$\text{GFR} = 186 \times (\text{creatinine})^{-1.154} \times (\text{age})^{-0.203} \times .742 \text{ (female)} \times 1.21 \text{ (African American)},$$

Table 1: Stage of Kidney disease based on GFR and Urinalysis

Stage	ICD-9	Urine Findings	GFR mL/min
I	585.1	Abnormal	>90
II	585.2	Normal or abnormal	60–89
III	585.3	Normal or abnormal	30–59
IV	585.4	Normal or abnormal	15–29
V	585.5	Normal or abnormal	<15

The approach to the treatment of chronic kidney disease is to identify afflicted patients and focus on the following areas: slow the progression of CKD; identify and treat the complications of CKD per se; identify and treat the associated co-morbid conditions; timely referral to the nephrologists and planning for kidney replacement therapy.

The most common causes of CKD include diabetes mellitus, hypertension, renal vascular disease, chronic glomerulonephritis, polycystic kidney disease, and tubulointerstitial diseases like urinary tract infection or obstruction. Few of these can be treated directly, but UTI and obstruction, as well as uncontrolled hypertension, renal artery stenosis, and active glomerulonephritis should be treated aggressively which may delay, prevent, or reverse the progression of kidney disease. For the majority of causes of CKD, however, no specific therapy is available. This includes the most common causes of CKD, diabetes mellitus and hypertension, although blood sugar and/or blood pressure control may slow progression.

Strategies to Slow the Progression of CKD

Control of Hypertension

Hypertension is both a cause and a complication of chronic kidney disease. No matter what the etiology of CKD is, control of hypertension is effective in slowing the progression of the disease. Systemic hypertension leads to nephrosclerosis and hastens the interstitial fibrosis in the kidneys that accelerates the loss of kidney function. Even without systemic hypertension, all types of CKD are associated with intraglomerular hypertension, which leads to progressive sclerosis of glomeruli, further accelerating the decline in GFR. The goal blood pressure should be <130/80 in non-diabetics, and <125/75 in diabetics or non-diabetics with proteinuria. Angiotensin converting enzyme inhibitors and/or angiotensin receptor blockers are the preferred antihypertensive agents since they are effective in lowering systemic hypertension as well as intraglomerular pressure.

Use of Angiotensin Converting Enzyme Inhibitors

Angiotensin-converting enzyme inhibitors have particular beneficial effects in patients with diabetic nephropathy or those without diabetes but with proteinuria. These drugs slow progression even in patients without systemic hypertension. Angiotensin receptor blockers are a new class of drugs, which may be used in patients who are intolerant of angiotensin converting enzyme inhibitors. Recent studies have shown that using the two classes of drugs together may be even more effective without additive side effects.

Angiotensin converting enzyme inhibitors and angiotensin receptor blockers reduce proteinuria, an effect that may—in itself—be renoprotective. These agents reduce proteinuria at any given level of blood pressure reduction more than other antihypertensive drugs. Risks associated with use of these drugs include dangerous hyperkalemia and acute kidney disease when they are used in situations associated with decreased glomerular filtration pressure such as dehydration or renal artery stenosis. Careful monitoring of potassium levels and serum creatinine is warranted when these drugs are used.

Protein Restriction

Protein restriction is effective in decreasing the signs and symptoms of CKD, but it is unclear if a low protein diet can slow the progression of kidney disease. The deferral of dialysis that may be seen with protein restriction has been documented, but whether this is the best approach needs to be individualized.

In those studies which have shown that protein restriction slows the progression of CKD, a low protein diet (0.6 g/kg) without supplements has generally been less effective than a very low protein diet (0.3 g/kg) supplemented by essential amino acid (or ketoacid) tablets, 10 g/day in divided doses with meals. Such an approach, however, raises additional issues of compliance and cost. Protein restriction also reduces proteinuria. In nephrotic patients, a progressive fall in proteinuria and rise in serum albumin may occur over several months, especially if chronic kidney disease is not severe. This response was seen in a very low protein diet (0.3 g/kg) supplemented by essential amino acids (10-20 g/day in divided doses with meals, but not in a conventional low protein diet (0.6 g/kg). This is a delicate balance, however, and such an approach at times leads to a fall rather than a rise in serum albumin.

Control of Hyperglycemia in Diabetics

Tight blood sugar control in diabetics has been shown to significantly decrease the rate of progression of CKD. In fact, the combination of tight blood sugar control and excellent blood pressure control may arrest the progression of early-stage diabetic nephropathy.

Prevent and Treat Symptoms and Complications of CKD

There are numerous complications and symptoms that are directly attributable to the CKD that may require treatment. The most common metabolic and hematologic abnormalities are addressed below.

Potassium Disorders

Disorders of potassium (K) homeostasis (both high and low potassium levels) may result in preventable morbidity and mortality. Potassium levels should be checked periodically in patients with kidney disease.

Hyperkalemia is a common disorder in patients with kidney disease, especially when the glomerular filtration rate falls below 20 ml/min (late Stage 4 CKD). Hyperkalemia may occur as a result of impaired tubular secretion of potassium (K) in patients with mild chronic kidney disease. It is more prevalent among diabetics with type 4 renal tubular acidosis and is frequently exacerbated by the use of certain drugs such as angiotensin converting enzyme inhibitors, angiotensin receptor blockers, NSAIDs, trimethoprim and non-selective beta blockers. Other contributing conditions include volume depletion leading to poor urine flow, severe hyperglycemia, constipation, and starvation. Especially in diabetics, poor oral food intake (e.g. preoperative periods) resulting in low serum insulin levels may cause or exacerbate hyperkalemia. High intake of certain food items (see below) can also lead to hyperkalemia in patients with impaired kidney function. Referral to a dietitian for a potassium-restricted diet is useful.

Emergent Hyperkalemia (K > 6.5 mEq/L)

Elevation of potassium (K) above 6.5 mEq/L is a medical emergency and needs immediate attention to prevent life threatening cardiac arrhythmia.

Urgent Hyperkalemia (K 5.5 - 6.5 mEq/L)

A more conservative approach is generally acceptable if a rapidly reversible cause is identified (e.g. oral potassium supplementation) and the patient is asymptomatic, and does not have electrocardiogram (EKG) manifestations of hyperkalemia. Discontinuation of offending drugs, adequate nutrition, moderate potassium restriction, administration of laxatives, and/or correction of pre-renal azotemia or metabolic acidosis with sodium bicarbonate is generally sufficient. Persistent hyperkalemia may require a more stringent dietary limitation although very low potassium diets (less than 40 mEq/L/day) may lead to protein malnutrition. If the cause for hyperkalemia is not readily identifiable and the elevation in serum potassium is mild, other measures can be instituted in the outpatient setting. Liberalization of sodium intake, administration of loop diuretics and thiazides may be used in selected patients, although their side effects (volume depletion, hyperuricemia, etc.) must be taken into account. Another option includes the use of sodium polystyrene sulfonate (SPS) or Kayexalate®. The usual dose for sodium polystyrene sulfonate is 30 grams given with 100 mL of a 20% sorbitol solution. This can be repeated every 4 to 6 hours as needed. Lower doses (5 to 10 grams with meals) can be used to control chronic mild hyperkalemia. Fludrocortisone, a potent mineralocorticoid may be used in patients with type 4 renal tubular acidosis (RTA). Refractory hyperkalemia should prompt a referral to a nephrologist.

Potassium Content of Foods

- Highest content (>25 mEq/100 g)—Dried figs, molasses, seaweed
- Very high content (>12.5 mEq/100 g)—Dried fruit (dates, prunes), nuts, avacados, brancereals, wheat germ, lima beans
- High content (>6.2 mEq/100 g)
- Vegetables: spinach, tomatoes, broccoli, winter squash, beets, carrots, cauliflower, potatoes
- Fruits: Bananas, cantaloupes, kiwi, oranges, mango
- Meat: ground beef, steak, pork, veal, lamb

Since the cause of hyperkalemia may be multifactorial and may differ from patient to patient, the choice of treatment of mild-to-moderate hyperkalemia may require different combinations of the recommendations.

After therapy is instituted, a follow-up potassium level should be performed within one week to ensure effectiveness of therapy and identify any need for further modification of the treatment regimen.

HYPOKALEMIA (K < 3.5)

Hypokalemia may occur as a result of diuretic therapy or kidney disease and may cause cardiac arrhythmia and muscle weakness. A fall in serum potassium of 1 mEq/L reflects a loss of about 200–400 mEq in total body potassium. Replacement by foods high in potassium (see above) is usually less effective than administration of oral potassium chloride (KCl). Slow release tablets or capsules can be used, in the following dosage: (a) for prevention of hypokalemia, potassium chloride 8–20 mEq/day; (b) for treatment of potassium depletion, potassium chloride 40–100 mEq/day.

Severe hypokalemia, defined as serum potassium level below 3.0 mEq/L, may require intravenous potassium replacement, especially in patients on digoxin or if it is anticipated that potassium losses will continue (e.g. vomiting, diarrhea, etc.) In the patient with kidney disease, replacement should be approached with caution. High potassium chloride doses must be used with more frequent measurements of the serum potassium. IV potassium chloride replacement should be given no faster than 10 mEq per hour. It is preferable to replace potassium as a chloride salt as opposed to potassium-citrate or potassium-bicarbonate; one exception to this may be renal tubular acidosis (the hypokalemic types) and chronic diarrheal states.

Calcium Disorders

The goal of therapy is to normalize serum calcium (Ca) to avoid development of renal osteodystrophy as well as neuromuscular and cardiovascular complications.

Calcium balance is altered in kidney disease patients. Low serum calcium is a salient feature of kidney disease and its occurrence is multifactorial. Contributing factors include 25-Vitamin D deficiency and low 1, 25 - dihydroxyvitamin D levels. The latter abnormality along with elevated PTH is part of the syndrome of secondary hyperparathyroidism, which begins early in the course of CKD, when patients enter CKD Stage 3. 25-Vitamin D deficiency is also highly prevalent in patients with CKD, something only recently described. Patients with 25-Vitamin D deficiency should have a course of repletion therapy. In patients with hypocalcemia and normal 25-Vitamin D levels, normocalcemia can be obtained in many patients by using measures other than vitamin D administration (see below).

Hypocalcemia (Ca < 8.0 mg/dL)

Hypocalcemia is rare in patients with kidney disease unless the glomerular filtration rate falls below 30 ml/min. Calcium may be low because of an associated hypoalbuminemia, and this needs to be corrected for when viewing the relevance of the laboratory result. A useful correction of calcium concentration for hypoalbuminemia is: Corrected calcium = Measured Ca + (4 - serum albumin) × 0.8. Hypocalcemia is frequently the result of associated hyperphosphatemia and decreased levels of 1, 25 - dihydroxyvitamin D3. Along with hyperphosphatemia, hypocalcemia contributes to secondary hyperparathyroidism and renal osteodystrophy. Treatment of hypocalcemia should be modified in response to phosphate (PO₄) levels. In patients with a serum phosphate above 4.5 mg/dL, calcium based phosphate binders are recommended. Calcium carbonate (1250 mg tablets containing 500 mg of elemental calcium) given as one to four tablets three times a day with meals is often effective. Calcium carbonate may also be administered as 420 mg tablets containing 168 mg of elemental calcium. Calcium acetate (667 mg tablets, two to four tablets a day with meals) may be used, but is more expensive. The use of calcium-containing phosphate binders will frequently raise serum calcium (although not necessarily normalizing it) by lowering serum PO₄. In hypocalcemic patients with normal serum phosphate, calcium-carbonate or calcium-acetate can be given between meals, which increase the absorption of calcium. The major side effect of these preparations is hypercalcemia. Once the calcium level is normal, total exogenous calcium should be limited to 2000 mg/day, which includes dietary calcium.

Refractory hypocalcemia, especially in normophosphatemic patients, may require the use of calcitriol (1, 25 - dihydroxyvitamin D3). This form of therapy is better instituted in consultation with the nephrologist, given the possibility that the patient may be suffering from "adynamic bone disease," in which case vitamin D treatment may be counterproductive. Correction of hypocalcemia through nutritional means, such as the use of dairy products, frequently results in an elevation of serum phosphate that is obviously undesirable.

Hypercalcemia (Ca > 11 mg/dL)

Spontaneous hypercalcemia is infrequent in chronic kidney disease patients, most often resulting from underlying conditions such as myeloma, sarcoidosis, and neoplasm. More commonly, hypercalcemia in this population is iatrogenic, resulting from the use of calcium-containing binders, either alone or in combination Vitamin D analogues. In patients treated with calcium carbonate or calcium acetate, temporary discontinuation or reduction of calcium-based binders usually results in normalization of serum calcium. It is important to remember that patients may be taking calcium carbonate (Tums®) to alleviate dyspepsia without recognizing them as a source of calcium. In patients not on exogenous calcium or vitamin D, the development of hypercalcemia should prompt a workup for an underlying condition.

When the Ca × PO₄ product exceeds 55, there is the possibility of undesirable precipitation of Ca in non-osseous tissues, including blood vessels. Use of Ca based PO₄ binders may transiently exacerbate the problem. Use of aluminum hydroxide (300 to 600 mg p.o. tid with meals) for periods not to exceed 7–10 days (to avoid aluminum toxicity) may be necessary. When the Ca × PO₄ product falls below this dangerous level, calcium-carbonate or calcium-acetate may be started. RenaGel®, a new polymeric resin that does not contain calcium may be used, and lanthanum, another newer non-calcium binder, is also now available, but the high cost of both limit their use in clinical practice.

Phosphate Disorders

Hyperphosphatemia (phosphate (PO₄) >4.5 mg/dL)

Adequate control of serum phosphorus is essential for preventing the development of secondary hyperparathyroidism and the occurrence of soft tissue calcifications. Hyperphosphatemia has been identified as an independent risk factor for mortality in hemodialysis patients.

Hyperphosphatemia is at the center of the pathogenesis of secondary hyperparathyroidism and renal osteodystrophy. As kidney disease progresses, retention of PO₄ leads to a fall in serum calcium, which in turn, stimulates secretion of parathyroid hormone (PTH) resulting in increased osteoclastic and osteoblastic cell activity (high bone turnover). Measurement of serum phosphate level and serum calcium level four times per year is recommended in patients with CKD.

Healthy individuals ingest about 1 to 1.8 grams of phosphorus a day. Patients with kidney disease may require restriction to 0.8 to 1.2 grams of phosphorus a day. Calcium carbonate or calcium acetate with meals (see treatment of hypocalcemia) should be the initial therapy when dietary restriction does not accomplish the target serum phosphate level of less than 4.5 mg/L. Aluminum hydroxide should be used sparingly and for short duration to avoid aluminum loading and toxicity. Citrate based compounds should not be administered concurrently with aluminum based binders because they increase aluminum absorption in the gut, and may cause aluminum intoxication. Keep in mind that sucralfate is aluminum based and should not be used in patients with CKD.

Hypoalbuminemia (Serum Albumin Less Than 3.5 g/dL)

Malnutrition in patients with chronic kidney disease is common, with serum albumin correlating inversely with mortality in dialysis patients. Early referral to a nutritionist is indicated in all patients with compromised kidney function. Preferably patients should see a nutritionist at least twice a year and more frequently when they reach pre-end stage kidney disease levels of glomerular filtration rate (< 20 ml/min). Protein intake may be assessed by 24-hour urinary urea nitrogen excretion (UN g/day).

$$\text{Estimated Protein Intake (g)} = [\text{UN} + (.031 \times \text{weight (Kg)})] \times 6.25$$

Note: Rule out other coexisting disease e.g. liver disease, chronic infection, protein-losing enteropathy or occult malignancy.

All patients with chronic kidney disease should have an assessment by a renal dietitian soon after diagnosis. Attention should be given to overall nutrition, including lipids, potassium, phosphate, sodium, protein, and energy. In patients with early or moderate chronic kidney disease, daily energy intake should be 35 kcal/kg body weight and daily protein intake should be 0.8 g/kg body weight. For patients with more severe chronic kidney disease or nephrotic syndrome, severe protein restriction in conjunction with a dietary supplement may be useful to prevent symptoms and reduce proteinuria.

Metabolic Acidosis ($\text{CO}_2 < 20$ mEq/L and serum pH < 7.40)

Metabolic acidosis is common in patients with chronic kidney disease and results from the accumulation of organic acids in plasma as well as impairment of kidney acidification mechanisms. Metabolic acidosis may contribute to patient feelings of ill health, may impair immune function, and exacerbate renal osteodystrophy. It is important to maintain serum HCO_3^- (measured as plasma CO_2) above 22 mEq/L.

Oral bicarbonate replacement in the form of NaHCO_3 tablets is indicated when the serum carbon dioxide falls below 22 mEq/L. The recommended dose of bicarbonate is 0.5 mEq/Kg/day, in divided doses. The 650 mg tablets contain 7.7 mEq Na and 7.7 mEq HCO_3^- . The target is to titrate serum carbon dioxide to 22 mEq/L. Sodium citrate is not recommended because it facilitates aluminum absorption through the gut, resulting in possible severe and acute aluminum toxicity.

Anemia

Anemia is a common consequence of chronic kidney disease, caused primarily by erythropoietin deficiency. Treatment of anemia minimizes the need for blood transfusions, improves exercise tolerance, decreases cardiovascular mortality, and promotes a sense of well-being. The evaluation of the cause of the anemia in patients with chronic kidney disease should be similar to that in patients without CKD, particular since iron deficiency and gastrointestinal (GI) blood loss may be more common in patients with CKD and be additional causes of anemia in this population. Measurement of erythropoietin level is not indicated for suspected anemia of kidney disease because the values are difficult to interpret in this setting.

The usual diagnostic indices for iron deficiency may not be applicable in chronic kidney disease patients. Chronic kidney disease may result in an increase in serum ferritin independent of iron status because ferritin is an acute phase reactant, increasing in the presence of inflammatory cytokines. Although the exact value of serum ferritin that would exclude a response to iron therapy is controversial, there is evidence that treatment with iron in patients with serum ferritin up to 200 ng/ml may result in an increase in the hemoglobin in up to 50% of patients.

Therefore, it is recommend that in all chronic kidney disease patients with anemia should have ferritin measured, and oral iron should be prescribed if the serum ferritin is < 200 ng/ml. If serum ferritin level is higher than this value, iron deficiency cannot be excluded and transferrin saturation (transferrin saturation % = serum iron \times 100%/total iron binding capacity) should be measured. If Tsat $< 25\%$, oral iron should be administered. Oral iron should be given in a daily dose equivalent to 200 mg elemental iron (typically ferrous sulfate 325 mg tid) for six months.

If the cause of the anemia is identified and treated and the hemoglobin remains < 10 gm/dl (or Hematocrit $< 30\%$), the patients should be referred to Nephrology/Hematology for further evaluation and consideration for epoietin therapy. Evidence suggests that treatment of chronic kidney disease patients to increase their hemoglobin to > 10 gm/dl lessens the chances for blood transfusion, and may improve quality of life and reduce cardiovascular morbidity. A patient, who has a hemoglobin of 10-12 gm/dL, and no symptoms, should be followed with a repeat hemoglobin on a quarterly basis or as clinical condition requires.

Volume Overload

Volume overload should be suspected in patients complaining of dyspnea, chest discomfort, orthopnea, paroxysmal nocturnal dyspnea, or progressive decrease in exercise tolerance. It may also be asymptomatic. Physical findings could include jugular venous distention, hepatojugular reflux, pulmonary rales, wheezing (in "cardiac asthma"),

and S3 or S4, ascites, and peripheral edema. Patients with chronic kidney disease may also have significant volume overload even in the absence of the above symptoms and signs. Chest films may show evidence of pulmonary edema or may be more subtle, showing only prominent pulmonary vasculature. The same findings may occur with heart disease, liver disease, and various other conditions, so the patient's change in weight over time is critical. Over weeks to months, these patients may lose lean body mass due to malnutrition and can develop fluid overload with relatively little change in weight. Therefore, serial assessment of patients' lean body mass is also critical.

Contributors include:

- Excess salt intake
- Progressive fall in GFR
- Fluid retention from blood pressure medications
- Inadequate diuretic therapy.

Consider fluid overload for sudden unexplained gains in weight, refractory hypertension, peripheral edema, or shortness of breath. These may be secondary to the above causes. Hyponatremia, developing as a result of water retention in excess of sodium retention, may also be a marker for volume overload in the above setting.

Management:

- Patients should be weighed at every visit
- Dietary sodium restriction to 2 gm/d
- Loop diuretics, and if refractory to twice daily dosing, consider adding thiazide-type diuretics
- If advanced chronic kidney disease, consider initiation of dialysis

Prevent and Treat Cardiovascular Disease

Patients with chronic kidney disease are much more likely to die from CVD than to survive to end-stage renal disease. It is essential, therefore to focus on CVD in this population, to identify and treat the traditional CVD risk factors, as well as those modifiable risk factors related to the chronic kidney disease including proteinuria and anemia.

Avoidance of Drug-Drug interactions, NSAIDs, and Other Nephrotoxic Drugs

Patients should be counseled about the possible adverse consequences of nonsteroidal anti-inflammatory drugs, which are in many over-the-counter cold and pain preparations. They need to understand that the kidney is a frequent target for toxic injury because it is a major route of excretion for a variety of drugs. It is also important to obtain a history of any alternative medical therapies the patient may be using. It has been reported that only 30% of patients who use alternative therapies ever mention it to their health care providers. Therefore it is important to attempt to establish rapport, so that the patient will share information. Occupational and environmental exposures as well as the use of cocaine, heroin, and amphetamines (Ecstasy) need to be explored as well.

The Q_o value of a medication is the fraction of the bioavailable dose that is eliminated extra kidneyly. A Q_o value of 0.30 means that 70% of the bioavailable dose is excreted unchanged in the urine, and whose dosage has to be adjusted in kidney disease. The following table lists the Q_o values of various drugs that may require dosage adjustments.

Table 2: Drugs with a Qo value ≤ 0.3

Drug	Qo-Value
Digoxin	0.30
Lithium	0.02
Aminoglycosides and vancomycin	
Amikacin	0.02
Gentamicin	0.02
Netilmicin	0.01
Tobramycin	0.02
Vancomycin	0.05
Lactam antibiotics	
Ampicillin	0.06
Cefaclor	0.25
Cefalexin	0.04
Virostatics	
Acyclovir	0.10
Cidofovir	0.13
Famciclovir	0.14
Ganciclovir	0.05
Lamivudine	0.03
Valaciclovir	0.10
Zalcitabine	0.30
Vigabatrin	0.01
H2-receptor antagonists	
Cimetidine	0.30
Famotidine	0.20
Nizatidine	0.30
Ranitidine	0.20
ACE Inhibitors	
Cilazapril(at)	0.20
Enalapril(at)	0.10
Quinapril(at)	0.20
Fibrates	
Clofibrate	0.10
Fenofibrate	0.20
Blockers	
Atenolol	0.12
Carteolol	0.30
Sotalol	0.15
Nadolol	0.25
Antiepileptic	
Gabapentin	0.02

Patient Education

In order to enhance patient adherence to treatment, patient education should begin soon after the diagnosis of chronic kidney disease. The importance of strategies to delay progression of kidney disease and avoid further kidney injury must be highlighted.

Few kidney disease education curricula have been published. The Canadian Pre-Dialysis Advisory Board developed one such program. Oschner Clinic Kidney Services developed a pre-end stage kidney disease education program in 1997 called "Healthy Start" that may serve as a resource. Both programs have received support from Baxter Healthcare Kidney Division through their Pre-End Stage Kidney Disease Education Program. This program provides a nurse educator, at no charge, to interested hospitals, clinics, or physicians. Most recently the NIH has developed the National Kidney Disease Education Program (NKDEP), which provides educational materials for physicians and patients. Finally, the National Kidney Foundation KEEP program provides screening and education for patients at risk of chronic kidney disease.

The two major areas that need to be included in the education program for patients and their families are discussed below.

General Overview

Anatomy and normal function of the kidneys, altered kidney function and the patient's disease process need to be explored. Laboratory tests and results, diet and medications should be reviewed. This can be done in small groups. Groups may be inappropriate, however, for patients who have low literacy skills or learning problems.

Control of Blood Pressure

Adherence to medications and dietary and lifestyle changes may reduce the rate of progression of kidney disease as well as reduce the risk of cardiac disease. For further information on this topic, please see the Veterans Administration/Department of Defense Clinical Practice Guideline for Diagnosis and Management of Hypertension in the Primary Care Setting (<http://www.pbm.va.gov/archive/htnvadodguidelines.pdf>).

Appropriate Regular Follow-up

The goal of regular follow-up is to detect early changes in kidney function, clinical status, and biochemical parameters in order to prevent or to attenuate uremic complications and, possibly, to slow the progression of chronic kidney disease.

The frequency of follow-up visits depends on the severity of chronic kidney disease. It is unlikely that patients with mild CKD (GFR > 60) will develop electrolyte disturbances, anemia, or uremic bone disease. Similarly, patients with normal kidney function and mild proteinuria (<1.0 g/24 h), in the absence of diabetes mellitus, are less likely to develop more serious complications of CKD. These patients, if they do not have other co-morbidities and if their kidney function has been stable, can be seen about two to three times per year to evaluate for possible progression of their kidney disease, monitor control of causative factors such as blood pressure and diabetes, and to reinforce patient education.

Serum electrolytes, blood urea nitrogen/creatinine, calcium/phosphorous (Ca/P), serum albumin and urinalysis should be done routinely at each visit. An asymptomatic patient with a stable level of hemoglobin (Hgb) at 10 g/dL or more should have his/her hemoglobin checked at least twice yearly. In diabetic patients who do not have macroalbuminuria, determination of microalbuminuria should be done at least yearly. It is advisable that a nephrologist be consulted, at least initially, for the care of patients with more advanced chronic kidney disease (GFR < 60 ml/min) and for patients with >1gm proteinuria/24 hours. Patients with nephrotic range proteinuria (>3g/24h) need additional work-up that may include kidney biopsy. There is a high possibility that chronic kidney disease will progress to end-stage-kidney-disease in patients with glomerular filtration rate less than 60 ml/min, should they not succumb to CVD. Many biochemical abnormalities that will eventually lead

to clinical symptoms associated with uremia are already detectable at this level of glomerular filtration rate. Education about end stage kidney disease and treatment options should be given to these patients. Attention should be given to dietary protein restriction, overall nutritional status, hyperlipidemia and electrolyte balance. These patients should be seen by a renal nutritionist at least twice yearly. They also need more frequent follow-up (usually every 2 to 3 months) in the clinic. The care of these patients could be transferred to a specialty clinic or could be coordinated between primary care physicians and the specialty clinic.

Table 3: Suggested Follow-Up Based on Stage of CKD

Stage	PCP Follow Up	Labs	Nephrology Consult
I	6 months	CBC, lytes, CA ²⁺ , PO ₄ , Alb, Bun, Cr	PRN
II	6 months	Same as above	PRN
III	3–6 months	Same as above	1 then PRN
IV	3–4 months	Same as above	6–12 months
V	3–4 months	Same as above	13 months

Patients with glomerular filtration rate <30 ml/min have severe chronic kidney disease and should be referred to a nephrologist without any delay. These patients are at high risk of developing uremic complications. They could also progress to end stage kidney disease in a relatively short time. By this time the patient should have a good knowledge about end stage kidney disease and its treatment. If hemodialysis is the treatment option, the patient should receive the instruction not to use the non-dominant arm for blood drawing. An exercise program to build up forearm muscle and to increase the size of forearm veins should be instituted. A permanent vascular access (preferably an arteriovenous [AV] fistula) should be placed no later than when the glomerular filtration rate is ~ 25 ml/min. If preemptive kidney allograft transplantation is an option, work-up for the patient and potential donors must be initiated. These patients obviously need frequent follow-up, usually every one to two months. They also need to be evaluated more frequently by a nutritionist.

Frequent follow-up visits are also indicated in patients with a rapid change in kidney function or in whom there are not enough data to determine the rate of progression of kidney disease. Other groups of CKD patients who need to be seen frequently are patients with poorly controlled blood pressure and diabetic patients with poorly controlled blood pressure or blood sugar, or both. Poorly controlled blood pressure (BP) (blood pressure >130/80 mmHg) can adversely affect the progression of chronic kidney disease in diabetics as well as in patients with chronic kidney disease from other causes. Poor glycemic control may also adversely affect the progression of diabetic kidney disease. It may be necessary to see these patients and to adjust their medications at least monthly until their blood pressure readings and/or their blood sugar are in the acceptable ranges. If hypertension or diabetes mellitus is difficult to manage, a consultation with a specialist may be appropriate.

When to Consult a Nephrologist

Referral to a nephrologist may be helpful to the primary care provider to:

- Assist with diagnosis of the cause of chronic kidney disease, including kidney biopsy
- Assist in ruling out reversible causes of elevated creatinine such as urinary tract obstruction
- Reinforce the need for aggressive blood pressure control and dietary management to slow the progression of the disease
- Jointly manage various complications of CKD such as, electrolyte disorders, hyperparathyroidism, anemia, and metabolic acidosis
- Evaluate when there is a significant progressive decline in GFR
- Evaluate patients with a GFR < 30
- Evaluate patients with a GFR < 60 who have no prior history of a nephrologist's consultation.

Preparation for Renal Replacement Therapy

Once there is evidence of progression of CKD, or at the latest when the GFR is <30 ml/min, the patient must be instructed to "save" the non-dominant arm for hemodialysis access (no venipuncture or IV), and physicians must avoid central lines (in particular subclavian, but also internal jugular (IJ) given the risk of IJ or superior vena cava (SVC) stenosis).

The various modalities of kidney replacement therapy, including hemodialysis, peritoneal dialysis, and preemptive transplantation, should be introduced once there is clear evidence of progression to renal replacement therapy. There are currently no age restrictions on the initiation of dialysis, thus the decision to withhold dialysis must be made in conjunction with a well-informed patient. The patient should also be referred to a nephrologist for full discussion of these issues—at the latest when the GFR is <30 ml/min—to enable realistic exploration of living donor transplant prior to the requirement for dialysis, and to ensure timely placement of dialysis vascular access.

HCC Implications

Under the CMS-HCC reimbursement model, it is now more important than ever for appropriate documentation to be in the medical records that supports the ICD-9 codes that appear on the claim. Medical record documentation should capture the patient's GFR in the progress notes; a lab result that is not captured in such a fashion is insufficient to support a diagnosis based upon an abnormal result. It is critical to document and address all abnormal lab results in the progress notes in order to substantiate any diagnosis based upon the lab abnormalities.

POST TEST QUESTIONS

Challenges and Controversies in Geriatric Medicine *Chronic Kidney Disease in Older Adults*

Multiple choice questions: choose the one best answer. Use answer sheet on Page 16.

1. Which of the following statements is False?

- a. The elderly can have significant CKD despite a normal serum creatinine measurement
- b. All else being equal, the same creatinine results in a lower calculated GFR in Females than Males
- c. All else being equal, the same creatinine results in a lower calculated GFR in Blacks than Whites
- d. All else being equal, the same creatinine results in a lower calculated GFR in Elderly than Young
- e. All of the above

2. Which of the following is True?

- a. Acceptable blood pressure measurements in a diabetic are the same as a non-diabetic
- b. Beta blockers are preferred initial antihypertensives for use in diabetics with stage II CKD
- c. Intraglomerular hypertension is not found unless there is also systemic hypertension
- d. Protein restriction may be effective in delaying the initiation of dialysis in CKD patients
- e. All of the above

3. Which of the following is NOT true regarding anemia of chronic kidney disease?

- a. Anemia is a modifiable risk factor
- b. Anemia is not a risk factor for progression of CKD
- c. Management of anemia in CKD includes ESAs (erythropoietin - stimulating agents) and iron supplementation
- d. Clinical trials with ESAs indicate that targeting higher hemoglobin levels do not improve survival and may increase cardiovascular morbidity
- e. None of the above

4. Which of the following is TRUE about CVD- cardiovascular disease in CKD?

- a. Patients with chronic kidney disease are more likely to survive to end-stage renal disease than to die from cardio vascular disease
- b. It is essential to identify and treat CVD risk factors including proteinuria and anemia
- c. There is insufficient evidence of role of medications, diet, lifestyle changes on reducing risk of cardiac disease and rate of progression of kidney disease
- d. All of the above
- e. None of the above

5. Which of the following is true regarding CKD?

- a. A GFR>90 in the setting of abnormal urine findings is sufficient to diagnose Stage I kidney disease
- b. The "Healthy Start" and "KEEP program" are useful patient education programs
- c. An asymptomatic patient with a stable hemoglobin at 10 mg/dl should have his/her hemoglobin checked monthly
- d. A and B
- e. All of the above

6. Which of the following is true regarding CKD?

- a. A CKD patient with uncontrolled hypertension and diabetes should be managed by a specialist
- b. Normalizing serum calcium is important to avoid development of renal osteodystrophy as well as neuromuscular and cardiovascular complications
- c. A GFR<30 or >60 should be referred to a specialist
- d. A and B
- e. All of the above

7. Which of the following is False?

- a. Angiotensin receptor blockers should be avoided in patients with CKD who are intolerant of converting enzyme inhibitors
- b. Diabetics with type-4 renal tubular acidosis are more likely to have complications of hyperkalemia even in early stage CKD
- c. CKD is one of the strongest indicators of patients who are at risk of cardiovascular disease
- d. Hypocalcaemia is rare in patients whose GFR is greater than 30
- e. Consideration must be given to the phosphate level when trying to decide how best to treat hypocalcaemia

8. Which of the following is True?

- a. Hyperparathyroidism does not begin until late in the course of CKD
- b. Long term use of aluminum hydroxide is acceptable as a phosphate binder since aluminum toxicity is no longer considered a serious complication
- c. It is not necessary to refer a patient to a nephrologist until their GFR has fallen to below 15 as long as the patient is monitored frequently
- d. Patient Education should begin soon after the diagnosis of CKD due to the fact that adherence to medications and dietary/lifestyle modifications may reduce the rate of progression of the kidney disease as well as reduce the risk of cardiac disease
- e. The COX-2 NSAIDs are safe to use in CKD patients

9. Please indicate which statement is False:

- a. Metabolic Abnormalities, Hematologic Abnormalities and Volume Overload are common complications of CKD that may require treatment
- b. Patients with CKD are more likely to die from Cardiovascular Disease than to survive to end-stage renal disease; therefore, it is essential to identify and treat the traditional Cardiovascular Disease risk factors in this population
- c. The dosages of the following medications: Digoxin, Cimetidine and Fenofibrate should be adjusted in patients with CKD
- d. In frail elderly, if a Serum Creatinine is within the normal limit, the GFR measurement is not necessary since "normal" serum creatinine is a good indicator of the absence of significant CKD
- e. Referral to a nephrologist may be helpful when the patient's GFR is significantly declining and the patient is anemic

10. Which statement is true?

- a. The elderly population has a low risk of developing of chronic kidney disease (CKD), so frequent clinical evaluations are not necessary
- b. Patient education should begin soon after the diagnosis of CKD due to the fact that adherence to medications and dietary/lifestyle modifications may reduce the rate of progression of the kidney disease as well as reduce the risk of cardiac disease
- c. Strategies to slow the progression of CKD include: Hypertension control, ACE inhibitor use, Protein restriction, and Control of Hyperglycemia in diabetics
- d. All of the above
- e. B and C

To receive your CME credits, please complete the following form and return via mail or fax to the address provided below.

LESSON EVALUATION FORM/POST TEST—CKD IN OLDER ADULTS

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Yes No

Post Test

	A	B	C	D	E
1.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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