Chronic Kidney Disease

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Outline

I. Definition
II. Risk Factors
III. Screening
IV. Epidemiology
V. Renal protection
VI. Complications
   I. Anemia
   II. CV disease

CKD Definition

- Kidney damage for > 3 months
- Structural or functional abnormality
- Proteinuria
- Abnormal urine sediment
- Abnormal renal imaging
- CrCl < 60ml/min/1.73m² for > 3 mos

CKD Stages

<table>
<thead>
<tr>
<th>Stage</th>
<th>CrCl Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>CrCl &gt; 90</td>
</tr>
<tr>
<td>Stage I</td>
<td>CrCl &gt; 90, with structural abnormalities or abnormal urinary findings (i.e.- hematuria, proteinuria)</td>
</tr>
<tr>
<td>Stage II</td>
<td>CrCl 60 - 89</td>
</tr>
<tr>
<td>Stage III</td>
<td>CrCl 30 - 59</td>
</tr>
<tr>
<td>Stage IV</td>
<td>CrCl 15 – 29</td>
</tr>
<tr>
<td>Stage V</td>
<td>CrCl &lt; 15</td>
</tr>
</tbody>
</table>
CKD Risk Factors

- Diabetes
- High blood pressure
- Family history of kidney disease
- Age
- Race – African American, American Indian, Hispanic, Asian, Pacific Islander

Epidemiology of CKD

- Among new ESRD patients:
  - Mean age 60
  - Just over 50% male
  - 40 – 50% diabetic

Screening at risk patients for CKD

- Serum creatinine
- Urinalysis
- Blood pressure

Incident & prevalent dialysis patient counts, & transplant patient counts

USRDS data include patients identified by the CMS ESRD program & the UNOS transplant program.
Incident counts & adjusted rates, by primary diagnosis

Figure 2.11

Renal Protection

Normal GFR Decline

- GFR declines in adults after age 45
- GFR decline attributed to aging is 1 ml/min/year
- GFR loss in CKD occurs at 4-10 ml/min/yr

Natural Progression of Kidney Disease

- Threshold is crossed when reduction in nephron mass > 50%
- Proteinuria > 500mg/day is also a threshold
Delaying Progression

- Sitting systolic SBP 120’s or less
- ACEI or ARB therapy
- 2 – 3 g /day Na restriction
- Control fluid intake (keep urine volume under 2 liters/day)
- Low protein diet 0.7g/kg/day

Anemia of CKD

- Anemia of CKD - Common once CrCl < 60
- Normochromic normocytic anemia
- RBC’s are fragile and have a shortened life span
- Inadequate stimulation of erythropoiesis
Anemia

• Ability of the failing kidney to produce EPO is impaired
• EPO is a glycoprotein essential for production of rbc’s
• Formation of heme in presence of EPO depends on adequate iron

Why treat anemia in CKD?

• Quality of life
• Exercise Tolerance
• Avoid transfusion

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Anemia

• Recombinant human EPO is available
• Start EPO once Hg < 10 in CKD
• EPO dose 150-300 units/kg/week
• rHuEPO may raise blood pressure

Anemia – Target Hg

2006 KDOQI – target Hg 11-13 g/dL

Nov 2006 NEJM – CHOIR
Correction of Hg and Outcomes in Renal Insufficiency – showed worse outcomes with higher Hg

Current target Hg is 11 – 12g/dL
**CHOIR**

- 1432 pts with CKD
- Randomized to target Hg 13.5 or 11.3g/dl
- Followed for 16 months

**Cardiovascular Disease in CKD**

- Composite endpoint of death, MI, stroke, hospitalization for CHF
- Higher Hg group had more events (125 compared to 97)
- Statistically significant with a p value of 0.03

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**CV Mortality - General Population vs ESRD Patients**

![Graph showing annual CVD mortality (%) vs age (years) for different categories: General Population, Male Dialysis, Female Dialysis, Male GP, Female GP, Black GP, White GP.](image)

Longitudinal follow-up and outcomes among a population with CKD in a large managed care organization. DS Keith et al. Arch IM Mar 2004

<table>
<thead>
<tr>
<th>CKD Stage</th>
<th>Rate of RRT over 5 years</th>
<th>Mortality rate over 5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1.1%</td>
<td>19.5%</td>
</tr>
<tr>
<td>3</td>
<td>1.3%</td>
<td>24.3%</td>
</tr>
<tr>
<td>4</td>
<td>19.9%</td>
<td>45.7%</td>
</tr>
</tbody>
</table>

References


Chronic Kidney Disease

Christopher Brown MD, MPH

Patient Case

• Chris is a 41 yo man with h/o reflux nephropathy

• PMH
  ✓ CKD Stage 4
  ✓ HTN
  ✓ Angina
  ✓ Secondary hyperparathyroidism
**Patient Case**

**Patient Interview with Chris**

**F/U and Prognosis**

- Patient received pre-emptive transplant
- His creatinine has been stable
- Cardiovascular mortality will be twice that of the general population
- Cardiovascular mortality of patients on HD is 7-8 times that of the general population

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**Outline**

- VI Complications
  - III. Hyperkalemia
  - IV. Hyperphosphatemia
  - V. Metabolic acidosis
  - VI. Secondary Hyperparathyroidism (SHPT)
  - VII. 25 Hydroxyvitamin D
- VII. Access planning
- VII. When to refer
Hyperkalemia

- Hyperkalemia is one of the more concerning complications of renal dysfunction
- It is defined as a potassium concentration greater than 5mEq/L (in some labs up to 5.5)

Danger lies in interference with the cardiac conduction system (next slide)

Results from decreased potassium excretion by kidney

- Electrocardiographic changes in hyperkalemia
  - Electrocardiographic (ECG) changes associated with hyperkalemia. A, Normal ECG pattern. B, Peaked, narrow-based T waves are the earliest sign of hyperkalemia. C, The P wave broadens and the QRS complex widens when the plasma potassium level is above 7 mEq/L. D, With higher elevations in potassium, the P wave becomes difficult to identify. E, Eventually, an undulating sinusoidal pattern is evident. Although the ECG changes are depicted here as correlating to the severity of hyperkalemia, patients with even mild ECG changes may abruptly progress to terminal rhythm disturbances. Thus, hyperkalemia with any ECG changes should be treated as an emergency.


Management
- Decreased intake
- Loop diuretics
- Avoid constipation
- Kayexalate
- Discontinue aldosterone blockers
- Discontinue ACE-I/ARB (Last resort)
- Renal replacement therapy
**Hyperphosphatemia**

- Goal differs based on renal function
  - Stage 3 and 4
    - 2.7 – 4.6 mg/dL
  - Stage 5 and ESRD
    - 3.5 – 5.5 mg/dL
- Contribute to the development of SHPT
- Elevated levels associated with worse cardiovascular outcomes

**Hyperphosphatemia**

- Treatment
  - Dietary restriction
  - Pharmacologic
    - Calcium based binder
      - Calcium carbonate
      - Calcium acetate
    - Non calcium based binder
      - Sevelamer
      - Lathanam carbonate

**Metabolic Acidosis**

- Serum bicarbonate level less <20
- Metabolic acidosis interferes with bone metabolism
- Replace with sodium bicarbonate
- Goal bicarbonate level of 21 - 25
SHPT

- Related to phosphorus and calcium levels
- Target varies with CKD stage
  - Stage 3 <70
  - Stage 4 <110
  - Stage 5 <300

SHPT

- Treatment
  - Control phosphorus
  - Keep calcium in normal range
  - Activated vitamin D
    - Calcitriol
    - Doxicalciferol
    - Paracalcitol
    - Alphacalcidol
  - Calcimimetic
    - Cinacalcet

25-Hydroxyvitamin D

- 25-hydroxyvitamin D levels can be decreased in patients with CKD
- Decreased levels of 25-hydroxyvitamin D contribute to SHPT
- The level should be checked annually
25-Hydroxyvitamin D

**Treatment**

<table>
<thead>
<tr>
<th>Serum 25(OH)D [ng/ml]</th>
<th>Definition</th>
<th>Ergocalciferol Dose (Vitamin D)</th>
<th>Duration</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5 (12)</td>
<td>Severe vitamin D deficiency</td>
<td>50,000 IU orally x 12 wks, then monthly</td>
<td>6 months</td>
<td>Measure 25(OH)D levels after 6 months</td>
</tr>
<tr>
<td>5-15 (12-37)</td>
<td>Mild vitamin D deficiency</td>
<td>50,000 IU orally x 4 wks, then 50,000 IU/month</td>
<td>6 months</td>
<td>Measure 25(OH)D levels after 6 months</td>
</tr>
<tr>
<td>16-30 (40-75)</td>
<td>Vitamin D insufficiency</td>
<td>50,000 IU/month orally</td>
<td>6 months</td>
<td></td>
</tr>
</tbody>
</table>

*No data for patients with GFR<20

Taken from http://www.kidney.org/professionals/KDOQI/guidelines_bone/images/table26L.jpg

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**Access Planning**

- **Temporary access**
  - Tunneled catheter
  - Non-tunneled catheter
- **Permanent access is preferred**
- **Planning for HD access starts in Stage IV**
- **The non-dominant arm is the preferred site**

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**Access Planning**

- **Dialysis access is the lifeline for the dialysis patient**
- **Permanent and non-permanent access**
- **Permanent access**
  - Fistula
    - At least 6 months prior to use
  - Graft
    - 3-6 weeks prior to use
- **Protection of the site for access**
  - Avoid venapunctures
  - No blood pressure cuff
  - Avoid PICC lines
  - Avoid Central lines
Access Planning

• Early education about access
  ✓ Helps patients adjust to the concept
  ✓ Empowers patients to protect future access site
  ✓ Allows patient to share information with family

When to Consult/Refer to Nephrologist

• Consult nephrologist at Stage 1 if hematuria or significant proteinuria present
• Consult nephrologist at Stage 2 if GFR declines > 4mL/min/yr
• Consider consult to nephrologist at Stage 3 for all patients with CKD
• Refer patient to nephrologist for evaluation when GFR < 30 mL/min/1.732

When to Refer to a Nephrologist

• Depends on comfort level of practitioner and patient
• If CKD stage I or II with proteinuria and without diagnosis of diabetes
• Hematuria at any stage
• Acute renal failure without clear etiology

References

• Noordzij, M. et. Al. Mineral Metabolism and Mortality in Dialysis Patients: A Reassessment of the K/DOQI Guideline
  Blood Purif 2008;26:231-237
  http://www.acponline.org/patients_families/about_internal_medicine/subspecialties/nephrology/
  http://www.kidney.org/professionals/kdoqi/index.cfm