Chronic Kidney disease following Acute Kidney Injury

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Traditional concept of AKI recovery

1. Pre-renal phase
2. Initiation
3. Extension
4. Maintenance
5. Recovery
Recovery post AKI

- Predictable
- Complete
- No long term sequelae
Clinical case

74-yr-old Mr. Patel has DM2, HTN, CAD, ischemic cardiomyopathy (EF 25%), CKD stage 3 is admitted with worsening SOB
Baseline s. creat. 1.8 mg/dl (eGFR 45 ml/min)
BUN 45 mg/dl

On admission:
Renal panel – s. creat 2.2, BUN 74, BNP 900
K – 5.7, CO2 19
Question?

- How will this creatinine change of 0.4 mg/dl affect his mortality?

A) No change
B) 30% increase
C) 50% increase
D) 80% increase
E) 100% increase
Acute Kidney Injury

- Small change in serum creatinine increases mortality
- Change as small as 0.3 mg/dl is associated with 80% mortality
- Independent risk factor of death

Chertow et al – JASN 2005
Acute Kidney Injury

- Increasing incidence, especially in hospitalized elderly patients
- Prolongs hospital stay
- Often requires ICU transfer/dialysis support
- Mortality remains high
AKI definitions

- Acute Kidney Injury Network (AKIN)
- Acute Dialysis Quality Initiative (RIFLE)
- KDIGO AKI criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>KDIGO</th>
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<tbody>
<tr>
<td>Urine Output</td>
<td>Change in serum creatinine</td>
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<tr>
<td>Change in eGFR</td>
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Patients with at least one recognized AKI event, with or without dialysis.

Medicare patients age 66 & older. USRDS 2013.
AKI by age – USRDS 2013

Percent of patients

Age

- 66-69
- 70-74
- 75-79
- 80-84
- 85+

Medicare
THMS
CDM

55-64
45-54
20-44
0-19
Rate of first AKI - 2011

- Rate of AKI is highly associated with age

- Age Rate

USRDS 2013
Lifespan – India

WHO Data

Kidney Disease: Improving Global Outcomes
Life expectancy in India goes up by 5 years in a decade

January 29, 2014 | Janani Sampath, TNN

CHENNAI: If your child was born in the last couple of years, he or she is likely to live five years more than children born a decade ago. Statistics released by the Union ministry of health and family welfare show that life expectancy in India has gone up by five years, from 62.3 years for males and 63.9 years for females in 2001-2005 to 67.3 years and 69.6 years respectively in 2011-2015. Experts attribute this jump — higher than that in the previous decade — to better...
Projected life expectancy

Comparison of projected life expectancy for countries:
- USA
- Europe
- China
- India

Source: http://www.china-profile.com/data/
Recurrent AKI

How likely will Mr. Patel require hospitalization for recurrent AKI in the next 12 months?

A. 10%
B. 20%
C. 30%
D. 40%
Recurrent AKI by age – 2010 -2011

USRDS 2013

Percent

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Original AKI: all</th>
<th>Original AKI: with dialysis</th>
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<tr>
<td>All</td>
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<td>66-69</td>
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USRDS 2013

Kidney Disease: Improving Global Outcomes
AKI and CKD - Interplay

- Do patients with AKI progress to CKD/ESRD?
- What happens to patients who already have CKD?
- Is CKD per se a risk factor for AKI?
CKD as a risk factor for AKI

- Alberta Kidney Disease Network study
  - 920,000 hospitalized patients
  - Stratified by eGFR and proteinuria
  - High risk for hospitalization with AKI
    - Lower baseline eGFR
    - Heavier proteinuria

James MT et al – Lancet 2010
Risk factors for AKI - proteinuria

- Proteinuria and hospitalization
  - Urine dipstick > 2+
  - 4.4 fold increased risk with AKI
  - 7.7 fold increased risk of AKI needing dialysis

James MT et al – Lancet 2010
CKD as a risk factor for AKI

- >20,000 pts. who underwent coronary angiography
- Radiocontrast induced AKI was studied
- eGFR <60 ml/min – 5-fold increased risk

Bartholomew BA et al – Am J. Cardiology 2004
Mr. Patel has recurrent episodes of AKI.

What is his likelihood of progressing to CKD 4?

A. Unlikely to progress
B. Doubles with each episode
C. 4X with each episode
D. Rapidly progresses to ESRD
Effect of AKI on CKD in a diabetic patient.

23% reached CKD 4

Thakkar et al – CJASN 2011
Frequency of all cause mortality with AKI & DM

High frequency – 38%

Thakkar et al – CJASN 2011
Survival to stage 4 CKD

Thakkar et al – CJASN 2011

No AKIs
1 AKI
2 AKIs
3+ AKIs

N = 1822  1731  1478  1126  762  16
Effect of AKI on CKD in DM

• 30% risk of recurrence of AKI after the 1st episode

• AKI is an independent risk factor for worsening of CKD

• Each episode of AKI doubles the risk of CKD progression

Thakkar et al – CJASN 2011
Duration of post-operative AKI in diabetics

- 123 Veterans Affairs Medical Centers
- > 35,000 veterans
- Long term mortality following AKI
- AKI was stratified by duration
  - Short – < 2 days
  - Medium – 3- 6 days
  - Long - > 7 days

Coca et. Al – KI 2010
Effect of duration of AKI

- Duration
- Mortality

Coca et. Al – KI 2010
AKI after cardiac surgery

- > 29,000 Veterans between 1999-2005
- AKI was stratified by percentage change in s. creat from baseline
  1-24%; 25-49%. 50-99%, > 100%
- 3-months after surgery – greater risk of Progression of CKD stage

Ishani et al – Arch Int Med 2011
Hazard ratios post cardiac surgery

Ishani et al – Arch Int Med 2011

Progression of CKD

Long term mortality

Kidney Disease: Improving Global Outcomes
How does AKI affect CKD?
How likely is Mr. Patel going to progress to ESRD in next 12 months with recurrent AKI admissions?

A. 10-15%
B. 25%
C. >50%
D. He will remain in CKD stage 3
Changes to CKD status in the year following an AKI, 2010-11

45% of patients remained in the same CKD stage prior to AKI.

11% of patients progressed to a more advanced CKD stage after AKI.

45% of patients had an unknown CKD status prior to AKI.

USRDS 2013
Changes to CKD status in the year following a recurrent AKI, 2010-11

USRDS 2013

Status after AKI:
- Unknown stage
- ESRD
- Stages 3-5
- Stages 1-2
- No CKD

50%
Changes to CKD status in the year following **AKI with dialysis**, 2010-11

USRDS 2013

61%

KDIGO

Kidney Disease: Improving Global Outcomes
AKI – CKD - interplay

Bucaloiu ID et al - KI 2012
Outpatient physician visits following initial AKI discharge, 2010–2011

- Primary care
- Cardiology
- Nephrology

Percent with a visit vs. Months after discharge:
- 3 months
- 6 months
- 9 months
- 12 months

USRDS 2013

Kidney Disease: Improving Global Outcomes
Discharge status following an AKI

- Home: 45%
- SNH: 31.1%
- Death: 10.2%
- ESRD: 1.4%
- Hospice: 4.8%

USRDS 2013
Summary

- AKI is under recognized
- AKI adds to morbidity and mortality
- AKI is a risk factor for both progression and development of CKD
- Need to identify high-risk patients - elderly, diabetes, duration of AKI
- Need to improve clinical follow-up posthospital discharge