Outpatient Dialysis for Patients With AKI: Clinical and Policy Considerations

Michael Heung, MD MS
Director, Acute Dialysis Program
University of Michigan Health System
Ann Arbor, MI

Disclosure Statement: No relevant disclosures to report.
Outline/Objectives

• Identify challenges to the clinical care of patients with AKI requiring dialysis on an outpatient basis

• Describe upcoming policy changes that will affect the care of these patients

• Describe approaches to improving outcomes in this population
Why Outpatient AKI?

- Increasing numbers of patients with severe AKI + better survival = more AKI outpatients needing dialysis
  - Among survivors, 10-30% remain dialysis-dependent at discharge
- Renal function recovery (dialysis independence) frequently occurs after discharge: 20-60% of survivors
  - A critical opportunity to improve outcomes in a high risk population

Hsu RK et al, JASN 2013;24:37-42

10% annual increase
Current Challenges

• Lack of evidence-based guidance for best practices
• Lack of large-scale follow-up data
• Logistical challenges
• Regulatory challenges (a moving target)
Medicare (CMS) Regulations

• 2012 rule clarification: “ESRD facilities cannot furnish acute dialysis to hospital outpatients... A hospital may not enter into an arrangement with an ESRD facility for the facility to provide, outside of the hospital, outpatient dialysis or any other therapeutic service for which the hospital would bill Medicare.”

• As a result, options for Medicare AKI patients requiring dialysis became more limited
# Current Options

<table>
<thead>
<tr>
<th>Dialysis Setting</th>
<th>Description</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inpatient</td>
<td>Prolong hospitalization while monitoring for renal function recovery</td>
<td>Continuity of care</td>
<td>Risk of nosocomial infections and other hospital-acquired complications</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Patient convenience</td>
<td>High cost and inefficient resource use</td>
</tr>
<tr>
<td>Hospital-based unit</td>
<td>Return as outpatient to hospital–based dialysis unit</td>
<td>Care in acute setting with expectations for recovery</td>
<td><strong>Burden of potentially significant travel back to hospital</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eligible for Medicare payment</td>
<td>Limited availability of such facilities compared with other options</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Higher costs compared with ESRD facility placement</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Few patients qualify</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Limited availability of such facilities compared with other options</td>
</tr>
<tr>
<td>Long-term acute care hospital or</td>
<td>Onsite provision of dialysis</td>
<td>Convenience for patients who continue to have acute medical or rehabilitation needs</td>
<td>Requires ESRD certification or single-payer agreement between hospital and facility (not billable to Medicare)</td>
</tr>
<tr>
<td>rehabilitation center</td>
<td></td>
<td></td>
<td>Lack of AKI-specific protocols to promote recovery of renal function</td>
</tr>
<tr>
<td>Community-based ESRD facility</td>
<td>Placement in outpatient ESRD facility</td>
<td>More accessible and convenient for patients</td>
<td></td>
</tr>
</tbody>
</table>

“Trade Bill” passed 6/29/15 (effective 1/1/2017) will open doors for dialysis of Medicare AKI patients in ESRD facilities

Implementation will require thoughtful planning between medical centers and ESRD facilities

– Appropriate transitions of care
– Adequate monitoring for renal recovery
– Avoidance of reverting to standard ESRD protocols

We must avoid letting these patients fall through the cracks
Factors Influencing Renal Recovery

**Non-Modifiable**
- Patient characteristics
  - Demographics
  - Comorbidities
- Baseline renal function
- Severity of AKI

**Modifiable**
- In-hospital care
  - Dialysis modality?
  - Anticoagulation?
  - Fluid overload?
- Outpatient care
  - Closer monitoring?
  - Avoiding intradialytic hypotension?
  - New therapeutic agents?
## Starting Point:

### AKI Dialysis ≠ ESRD Dialysis

<table>
<thead>
<tr>
<th>Parameter</th>
<th>AKI</th>
<th>ESRD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comorbidities</td>
<td>Acute</td>
<td>Chronic</td>
</tr>
<tr>
<td>Kidney function recovery</td>
<td>Expected</td>
<td>Not expected</td>
</tr>
<tr>
<td>Monitoring for recovery (lab checks, urine output)</td>
<td>Essential - Weekly?</td>
<td>Not routine Monthly core indicator labs</td>
</tr>
<tr>
<td>Dialysis fluid removal</td>
<td>Balance volume overload versus hemodynamic instability</td>
<td>Establish dry weight</td>
</tr>
<tr>
<td>Bone and mineral metabolism</td>
<td>Targets uncertain</td>
<td>Targets established</td>
</tr>
<tr>
<td>Anemia management</td>
<td>Targets uncertain</td>
<td>Targets established</td>
</tr>
<tr>
<td>Vascular access</td>
<td>Catheters expected</td>
<td>Catheters avoided</td>
</tr>
<tr>
<td>General approach</td>
<td>Individualized</td>
<td>Protocol-driven</td>
</tr>
</tbody>
</table>
Monitoring for Renal Recovery

• Who?
  – Patient and care team
  – Importance of setting expectations

• How?
  – Clinical and biochemical criteria

• How often?
  – At least weekly, particularly in the early period
Indicators of Renal Recovery

• Clinical indicators:
  – Increasing **urine output**
  – Decreasing interdialytic weight gain
  – Improved sense of well-being

• Biochemical indicators:
  – Spontaneous decline in serum **creatinine**, phosphorus, others
  – Increase in measured creatinine clearance (timed **urine collection**)

• Importance of **active surveillance**


AKI on CKD (n=440)
Approach to RRT Discontinuation

• No evidence basis or guidelines
  – No discussion in KDIGO AKI guidelines (2012)

• Tapering (reduced treatment time and/or frequency) versus cessation

• Monitoring for complications

• Importance of medication dose adjustments
  – Antibiotics
  – Phosphate binders
Fluid Management

• ESRD: Establishment of “dry weight” via “challenges”
  – Dry weight defined as the point below which patient becomes symptomatic (hypotensive and/or cramping)
  – Although some more objective criteria exist (e.g. bioimpedance, real-time hematocrit sensing), these have not supplanted clinical approach

• AKI: Focus on avoiding complications of fluid overload while avoiding intradialytic hypotension
  – Ischemic insults may delay/impair renal recovery
  – Supportive evidence from studies comparing CRRT versus IHD
Intradialytic Hypotension

- The most common complication of HD, occurring in up to 30% of all treatments
  - Defined by BP threshold, BP drop, symptoms, and/or need for intervention

- Results from imbalance between ultrafiltration and capillary refill
  - Impaired autonomic response
  - Endothelial dysfunction
  - Underlying comorbidities

- Consequences include:
  - Myocardial injury/stunning
  - Cerebral ischemia
  - Increased mortality
  - Kidney injury???
Approaches to IDH

1. Increase HD treatment time and/or frequency
2. Ultrafiltration modeling
3. Cool dialysate
   - Eldehni (*JASN* 2015): RCT of cooled dialysate vs 37°C (n=73)
     • Cool dialysate associated with less hemodynamic instability and less evidence of brain ischemia (white matter changes) at 1 year
   - Odudu (*CJASN* 2015): same RCT
     • Cool dialysate associated with less progression of cardiomyopathy

_Caveat: Lack of data looking specifically at renal injury or renal function recovery_
What About Peritoneal Dialysis?

• Potential advantages:
  – Preservation of residual renal function/promotion of renal recovery
  – Avoidance of catheter-related bloodstream infections
  – Less inflammation and hemodynamic instability compared to standard HD

• Moist (*JASN* 2000): In new ESRD patients, compared to HD, PD associated with lower loss of residual renal function (adj OR 0.35, p=0.0001)
**PD for AKI**

**Mortality Outcome**

<table>
<thead>
<tr>
<th></th>
<th>PD</th>
<th>EBP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Events Total</td>
<td>Events Total</td>
<td>Odds Ratio</td>
</tr>
<tr>
<td>A Cohort Studies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hadidy 1989</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Chow 2007 (A)</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>Kumar 1990</td>
<td>25</td>
<td>42</td>
</tr>
<tr>
<td>Chow 2007 (B)</td>
<td>12</td>
<td>26</td>
</tr>
<tr>
<td>Werb 1979</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>Bellomo 1995</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Mahajan 2006</td>
<td>46</td>
<td>95</td>
</tr>
<tr>
<td>Watcharotone 2011</td>
<td>47</td>
<td>62</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>270</td>
<td>444</td>
</tr>
<tr>
<td>Total events</td>
<td>159</td>
<td>260</td>
</tr>
</tbody>
</table>

Heterogeneity: $\tau^2 = 0.18; \chi^2 = 9.65, \text{df} = 7 (P = 0.21); I^2 = 27%$

Test for overall effect: $Z = 0.15 (P = 0.88)$

<table>
<thead>
<tr>
<th></th>
<th>PD</th>
<th>EBP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Events Total</td>
<td>Events Total</td>
<td>Odds Ratio</td>
</tr>
<tr>
<td>B Randomized Studies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arogundade 2005</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>George 2011</td>
<td>18</td>
<td>25</td>
</tr>
<tr>
<td>Phu 2002</td>
<td>17</td>
<td>36</td>
</tr>
<tr>
<td>Gabriel 2008</td>
<td>35</td>
<td>60</td>
</tr>
<tr>
<td>Subtotal (95% CI)</td>
<td>125</td>
<td>123</td>
</tr>
<tr>
<td>Total events</td>
<td>70</td>
<td>58</td>
</tr>
</tbody>
</table>

Heterogeneity: $\tau^2 = 0.77; \chi^2 = 7.29, \text{df} = 2 (P = 0.03); I^2 = 73%$

Test for overall effect: $Z = 0.68 (P = 0.50)$

- Paucity of high-quality data
  - Mostly from resource-poor regions
- High variability between studies
- Similar mortality outcomes compared to HD

Chionh et al, *CJASN* 2013;8:1649-60
PD for AKI: Renal Recovery

- Gabriel (KI 2008): - RCT of high-volume PD vs. daily HD in pts with ATN (n=120)
  - Similar renal recovery rate (83% vs 77%, p=0.84) but shorter duration of RRT need (5.5d vs 7.5d, p=0.02)

- Phu (NEJM 2002): - RCT of PD vs HF for infection-related AKI (n=70)
  - PD associated with longer initial RRT course (92h vs 43.5h, p=0.006) and higher need for additional RRT (70% vs 37%, p=0.04)

- Ponce (Int Urol Nephrol 2013): - RCT of HVPD vs extended daily HD in pts with ATN (n=143)
  - Similar mortality (63.9% vs 63.4%, p=0.94)
  - Similar renal recovery (29.6% vs 26.9%, p=0.11)
  - Similar duration of RRT (9d vs 11d, p=0.58)
Potential Role of PD?

• Theoretical benefit over HD for renal function recovery
  – At present, not enough evidence to clearly support a role

• Testable hypothesis: Early conversion to PD around hospital discharge may increase likelihood of renal function recovery
  – Compared to standard IHD?
  – Compared to daily extended HD?

• Potential pitfalls:
  – Training of an acute patient population
    • New urgent start PD programs, or assisted PD
  – Follow-up and monitoring of recovery
  – Metabolic effects (glucose)
  – Peritonitis risk (fluid overload)
Ancillary AKI Management

• Anemia management:
  – Theoretical benefits, animal model evidence for ESAs as AKI prophylaxis
  – Not supported by clinical trials
  – No studies for renal recovery
  – Approach to minimize transfusions seems reasonable

• Metabolic Bone Disease:
  – No evidence to guide treatment targets

• Vascular Access:
  – Timing uncertain

Practice Models

• With little/no evidence basis or guidelines, each center must adopt their own best practices
  – Importance of local resources, expertise, patient population, regulations

• But, we can learn from each other...
Published Experience

- Mayo Clinic (Hickson *AJKD* 2015)
  - Renal function recovery 50% in de novo AKI by 6 months

- UVA “TECU” (Gautam *Nephron Clin Pract* 2015)
  - Renal function recovery 42% by 90 days

- Wisconsin DGF clinic (Muth *Am J Transplant* 2015)
  - Shorter hospital LOS, lower rates of acute rejection

- Michigan experience
  - Renal function recovery 45.2% by 90 days
Common Themes

• Dedicated resources
  – Limited pool of staff

• Local focus
  – In part driven by logistical factors

• Importance of AKI expertise
  – Departure from ESRD protocols, especially around fluid management

• Close monitoring
  – At least weekly assessment and lab testing
Summary

• Patients with AKI requiring dialysis upon discharge are a high-risk population

• With passage of “Trade Bill”, we may see a shift of outpatient dialysis for AKI from hospital-based units to ESRD facilities

• There is currently a lack of evidence-basis to guide AKI-specific dialysis protocols
  – Close monitoring for recovery is necessary
  – Avoidance of intradialytic hypotension is likely to be important

• Programs are encouraged to share their approaches and outcomes in order to identify best practices