Hospital Care and Treatment Options for COVID-19 Positive Patients with ESKD and AKI

Welcome and Opening Statement

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Yale School of Medicine
Report from the Front Lines

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Bronx, New York

Coronavirus cases in the U.S.
April 2, 2020

Confirmed Cases
236,339

Deaths
4,906

https://gisanddata.maps.arcgis.com
## NYC: EPICENTER OF COVID PANDEMIC

### NYC/WESTCHESTER TIMELINE MARCH 2020

<table>
<thead>
<tr>
<th>All COVID-19 confirmed patients in Westchester and New York City</th>
<th>March 3, 2020</th>
<th>March 7, 2020</th>
<th>March 17, 2020</th>
<th>March 31, 2020</th>
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<tr>
<td><strong>Affected geographical areas</strong></td>
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<td>International travel to affected geographic areas within 14 days</td>
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<td>• South Korea</td>
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<td>National geographical areas</td>
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<tr>
<td>• New Rochelle and New York City</td>
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<td>• Washington State</td>
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<tr>
<td>Global spread</td>
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<td>Now largely community transmission without known exposure</td>
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Mokrzycki MH and Coco M. Kidney 360 March 2020
Limited testing capability

SARS-CoV-2 Final Verified Test Results – MMC

Montefiore Medical Center COVID-19 + Daily Census
Positive Cases Currently Admitted

Montefiore Medical Center Total Case Count
**MANAGEMENT OF ESKD COVID PATIENTS IN ED**

Figure 1: Management of ESKD COVID+ and PD in the emergency department.

**Hospital Nephrology Services: COVID+ Census for March**

- **Hemodialysis patients:**
  - 47 patients
  - Deaths 8.5%

- **AKI:**
  - 109 patients
    - 69% male
  - ICU: 46%, RRT: 45%, HD not offered: 14%
  - Discharged 5%
    - 1 HD dependent (AKI on CKD)
  - Deaths 31%
    - *Limited follow-up period

Data provided by: Maria Coco MD, Molly Fisher DO, Ladan Golestaneh MD, Louis Tingling RN, Deep Sharma MD
Nephrology Transplant Service: Hospitalized patients COVID+ Census for March

• Renal transplant patients:
  • 24 patients
    • 78% male
  • Discharged 33%
  • Deaths 17%*

*limited follow up available

Data provided by Enver Akalin MD

Hemodialysis for hospitalized patients on cohorted COVID floors

COVID-19 and PUI patients with a fever, HBV+ or who are intubated
  • Receive bedside hemodialysis in their room using a portable hemodialysis machine with reverse osmosis, which is hooked up to the plumbing “Acorn” water source.
  • The efflux goes directly into the designated drain to prevent excess splash.
  • The dialysis machine is cleaned and disinfected with a 1:100 bleach wipes. The machines are not dedicated to any individual patient. The tubing and dialyzers are discarded in the red hazardous waste bins.
  • Requires 1:1 HD staffing-strain on resources

COVID-19 and PUI patients who are no longer coughing, and if it has been more than 7 days after symptom onset, or 72 hours afebrile
  • May receive hemodialysis at inpatient dialysis unit
  • Cohorting COVID-19 patients on the last shift
  • Performing a terminal clean
  • Improved patient:nurse staffing ratio
  • Safe transport through hospital hallways/elevators
Renal replacement therapy in hospitalized critical patients in ICUs

COVID-19 and PUI patients in the ICUs
- Receive either a continuous renal replacement modality (CVVHD or SLED), or intermittent hemodialysis depending on their level of acuity
- Use of extra-long tubing to allow for staff to access machine outside glass door in ICU
- The CVVHD effluent goes directly into the designated drain to prevent excess splash without need for additional processing.
- The CRRT machines are cleaned and disinfected with a 1:100 bleach wipes. The machines are not dedicated to any individual patient. The tubing and dialyzers are discarded in the red hazardous waste bins.

Optimize use of CVVHD for 2-3 patients/day
- 8 hr treatment times
- High dialysate flow 30-40ml/kg/hour

Downside
- Requires 1:1 staffing

Protection of HCPs
- Protection of HCPs
  - Patients remain masked during RRT procedures
  - Droplet precautions are maintained. The dialysis staff uses full PPE, including isolation gowns, masks, appropriate eye protection and gloves
  - Dialysis staff should have limited direct exposure to the patient
  - Extra long tubing to distance staff
  - HD staff are now using baby monitors to remotely monitor the patient during HD treatments from the doorway

Rounding Nephrology Staff
- Limit the number of staff entering the patient room for physical exam
- Communication with primary team about patient complaints/exam and treatment plan
- Full PPE use when required to enter patient’s room
- Updated hospital protocol
  - All hospital associates now wear a mask the entire time in hospital
  - Non clinical staff: surgical masks
  - Clinical staff:
    - Provided one N95 mask and face shield
    - Reuse protocol to be implemented soon: Sterilization of N95 Masks with Ethylene Oxide
Increasing nursing staffing for 1:1 treatments and staff shortages due to illness or quarantine

<table>
<thead>
<tr>
<th>Census</th>
<th>Jan/Feb</th>
<th>Late March</th>
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<tbody>
<tr>
<td>HD off units</td>
<td>~8-12</td>
<td>~18-25</td>
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<tr>
<td>Acute PD</td>
<td>0</td>
<td>~8-9</td>
</tr>
</tbody>
</table>

*2-3 fold increase in HD nursing staffing*

*Increase in level of care required of floor nursing*

**CHALLENGES DURING COVID CRISIS**

Adaptations in response to the rising number of COVID patients requiring renal replacement therapy (RRT)

- Increased threshold for RRT initiation
- Increase use of potassium binders, sodium bicarbonate and diuretics to manage medically
- Reduction in HD treatment frequency to 2x weekly
- Shorten treatment times significantly, where clinically able
- Open the inpatient HD unit on Sundays
- Increase in HD Nursing staffing on Sundays
  - Previously 1 on-call nurse which has been increased to 3 nurses schedule to come in
- Increase number of COVID designated ICUs
- Increase patient rooms on COVID cohorted floors with necessary HD plumbing
- Increase number of HD machines, CVVHD machines, SLED machines
- Initiating more AKI patients on urgent/acute peritoneal dialysis
  - IR and transplant surgery place Tenckhoff catheters via fluoroscopy or laparoscopy
  - Creation of a PD rounding service (nephrology attending, fellow, nursing)
- Purchase of more cycler PD equipment
  - Conserves nursing time and reduces staff exposure
  - Conserves on the use of PPE
- Palliative care consultation where appropriate
Communication and collaboration are keys to success during this rapidly changing health crisis

- Several COVID task forces were established at the onset of pandemic
  - Hospital administration-medical-nursing staff
  - Healthcare Epidemiologist
  - ICU teams
  - Nephrology task force
    - Lead by Nephrology Division Chief, Dr Michael Ross
    - Dialysis nursing manager and administration
    - Key Renal division members
- Hospital website COVID resources
  - Daily protocol updates
  - COVID treatment research protocols
  - Clinical COVID management protocols
    - Renal, ID, Pulmonary, Cardiology

EXTERNAL COMMUNICATION

Additional communication and information resources

- Frequent email updates and/or webinars:
  - NYC Department of Health
  - Representatives from our Large Dialysis Organizations Partners
    - DaVita Kidney Care
    - Fresenius Kidney Care
Practical Aspects of RRT In Hospitalized Patients With COVID-19 With AKI or ESKD

ANITHA VIJAYAN, MD, FASN
Washington University in St. Louis, MO

Disclosure

• NxStage – Critical Care Advisory Board Member
MANAGEMENT OF COVID-19 PATIENTS WITH AKI

**ACUTE KIDNEY INJURY**

- Presence of life threatening complications?
- Not responding to medical management?
- Initiate RRT if a suitable candidate

**Volume overload**
- Hyperkalemia
- Metabolic acidosis
- Uremia
- Severe oligoanuria

**Indications to start RRT**
- Volume overload/Respiratory failure
- Hyperkalemia
- Metabolic acidosis
- Uremia
- Severe oligoanuria

**BE WARY OF AGGRESSIVE FLUID RESUSCITATION**
**BALANCED CRYSTALLOIDS**
**TRIAL OF HIGH DOSE LOOP DIURETICS**
**NO DATA TO SUPPORT EARLY INITIATION OF RRT IN COVID PATIENTS**
MODALITIES OF RRT

• CRRT
  • CVVH
  • CVVHD
  • CVVHDF

• PIRRT (prolonged intermittent renal replacement therapy)
  • Various terminologies – SLED, AVVH, (Others)

• Intermittent HD

RRT MODALITIES IN AKI

CRRT

• Preferred modality of RRT in hemodynamically unstable patients (KDIGO)
• Convective clearance – hypothetical benefit in sepsis/SIRS
• No data to suggest convective over diffusive clearance for patient outcomes

Use the established CRRT modality at your institution
No need to buy a different kind of machine from what is used at your center
You may need more machines based on COVID projections for your city and your hospital

PIRRT

• Hybrid therapy
• Can be performed either with IHD or CRRT machines
• Does not need 1:1 hemodialysis nursing
• Allows one machine to be used for 2 patients

DOSING OF PIRRT

• Dose (simple calculation)
  • 20 ml/kg/hour dose for 24 hours, divided by # hours on treatment
• Duration - 10 hours or shorter
  • Allows time for cleaning, then using it for another 1-2 patients

SLED PRESCRIPTION

- Fresenius 2008 T
- Blood flow: 200 ml/min
- Dialysate flow: 100-200 ml/min
- 8-10 hours

ANTICOAGULATION IN CRRT/PIRRT

Anticoagulation during CRRT/PIRRT in COVID-19 patients with AKI is essential

- **Heparin**
  - Via machine circuit
  - Systemic
  - Our heparin protocol
    - PTT 60 – 80 secs

- **Citrate**
  - ACD-A or Tri-sodium citrate
  - Multiple citrate protocols
  - Nursing intensive
  - Risk for patient safety issues if implemented hastily
  - If your center is NOT using citrate already, do not recommend starting new protocol
IHD in AKI
- Standard
  - 3 times/week, Kt/Vurea 1.3/treatment (per KDIGO)

Considerations during COVID-19 pandemic
- Not every patient needs 4 hour HD
- Consider shortest duration that achieves metabolic and volume control
- Minimize 1:1 RN time in room
Hemodialysis Catheter

- HD catheters are usually placed by nephrologists and intensivists
- During pandemic, additional physicians/providers are being recruited to place catheters
- Catheter lengths are extremely important to ensure adequate blood flow and reduce clotting
- Create a cheat sheet to share with everyone

- **RIGHT IJ (preferred): length 15 cm**
- **Femoral: length 24-30 cm**
- **LEFT IJ: length 20 cm**
- Last resort – Subclavian: length 20 cm

AVG and AVF

- **Used for stable patients who need IHD**
  - Hemodynamically unstable patients in ICU may need catheter
- **AVG/AVF can be used for CRRT and PIRRT**
  - *Exsanguination* is a major concern
  - 1:1 nursing is required
  - If not normally done at your institution, recommend placement of temporary catheter for CRRT and PIRRT
  - Video monitoring is helpful – baby monitors have been used

Managing resources

• Delay RRT (if possible) in COVID PUI (conserves PPE)
  • If COVID-19 results are available within 24 hours
  • High dose diuretics (not feasible in ESRD)
  • Binders to lower K

• Decrease flow rates in CRRT
  • Consider 15 ml/kg/hour once metabolic control is achieved?

• Pharmacy compounding CRRT solutions?
• Using HD machine to do PIRRT?

Managing resources

• Cross training on setting up/monitoring RRT equipment
  • Nephrologists
  • Other nurses
Creative CRRT/PIRRT maneuvers during pandemic

- Minimize exposure to nurses and physicians
- Conserve PPE

PATIENT SAFETY FIRST
COORDINATION OF CARE

- Multi-disciplinary rounds at specified time
  - Nephrologist, ICU physician, ID physician, Cardiologist
- Review plan for day
- Ultrafiltration goals
- Medication dose adjustments
- Goals of care – escalation vs de-escalation
  - ?ECMO
Summary

• CRRT, PIRRT, IHD are all accepted modalities for delivering RRT
• CRRT/PIRRT is preferred in hemodynamically unstable patients
• PIRRT using CRRT equipment will free up machines/nursing
• Anticoagulation is essential (based on expertise at your institution)
• Appropriate catheter length is important
• Creative ways to minimize nursing exposure WITHOUT compromising PATIENT SAFETY
• Conserve resources
Peritoneal Dialysis (PD) Was Initially Used for Acute Kidney Injury (AKI)

- **TREATMENT OF UREMIA AFTER ACUTE RENAL FAILURE BY PERITONEAL IRRIGATION**

  HOWARD A. FRANK, M.D.; ARNOLD M. SELIGMAN, M.D.
  and
  JACOB FINE, M.D.
  Boston

JAMA 1946; 130(11):703–5

Advantages of PD for Acute Kidney Injury Treatment

- An option where resources or capacity for acute dialysis and CVVHD/HDF has been exceeded
- Continuous renal replacement therapy
  - hemodynamically unstable patients
- Minimal infrastructure requirements lower costs
  - Has been an option for many low/middle-income countries
- Avoids vascular access
  - Reserves limited vascular access sites for other purposes
- Avoids systemic anticoagulation
  - No concern in patients with bleeding diatheses or contraindications to systemic anticoagulation
- Less nursing time with direct patient exposure
  - Theoretically need to be present for connect and disconnect if on cycler
Concerns about PD For Acute Kidney Injury Treatment

- Less predictable fluid removal rates
  - transport characteristics unknown
- Solute clearance
  - hypercatabolic patients
- Treatment team comfort in critical care environment
- Complications
  - Infectious: peritonitis
  - Mechanical: catheter dysfunction and leaks since using catheter with short break-in period
- Deleterious impact of PD on respiratory biomechanics in mechanically ventilated patients
  - Prone ventilated patients

High volume PD vs. Daily HD for AKI

120 patients randomized to High Volume PD vs. Daily Hemodialysis

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Outcomes according to treatment group</th>
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<tbody>
<tr>
<td></td>
<td>HVPD (n=60)</td>
</tr>
<tr>
<td>Mortality (%)</td>
<td>58</td>
</tr>
<tr>
<td>Recovery of kidney function (%)</td>
<td>8.3</td>
</tr>
<tr>
<td>Duration of treatment (days)</td>
<td>5 ± 2.7</td>
</tr>
<tr>
<td>Resolution of acute kidney injury (days)</td>
<td>7.2 ± 2.6</td>
</tr>
</tbody>
</table>

DHD, daily hemodialysis; HVPD, high volume peritoneal dialysis.

Gabriel et al Kidney Int 2008;73:s87-s93
Absolute and Relative Contraindications

- Recent breach of peritoneum (abdominal surgery)
- Peritonitis, bowel compromise/inflammation
- Severe hyperkalemia (similar to CVVHD/HDF)
- **Severe respiratory failure and pulmonary edema**
- Shock liver with **severe lactic acidosis** (lactate containing PD solutions)
- **Ascites and high intrabdominal pressure**
- Prone ventilation?

PD Catheter Insertion for AKI

- **Flexible Tenckhoff PD catheter preferred over rigid catheter**
  - One cuff or two cuffs
  - Can serve as long term access if needed

- **Methods of insertion**
  - Percutaneous with or without fluoroscopic guidance
  - Patients often too ill for OR and advanced laparoscopic placement
  - Should be dictated by local resources, expertise, and comfort
  - Need an operator who is motivated and enthusiastic

- **Should use prophylactic antibiotics at the time of insertion**

- **Short break in period 24-48 hours**
  - Longer break in lower risk of peri-catheter leak
  - Other leak risk factors – obesity, diabetes, immunocompromised
  - Method of insertion plays a role
  - If leak develops may need to hold PD and/or reintroduce with low dwell volumes

Wikdahl et al, NDT 1997
Gedallah et al AJKD 2000
PD Prescription Considerations

- Lower dwell volumes to start i.e. 1L
  - Minimizes risk of mechanical complications gradually increase over time
  - In ventilated patients minimizes risk of respiratory compromise via impairment of diaphragmatic excursion
- Can use manual exchanges or cycler-based PD
  - For significant volume removal manual may be more challenging
  - Manual may be easier if there is slow inflow and outflow
  - Based on availability of nursing and comfort with automated PD troubleshooting
- Can use high volume q60 minute exchanges continuously for 24 hours in intubated patients
  - With prolonged inflow and outflow or excessive alarms consider tidal PD
  - Start with 2.5% glucose exchanges if fluid removal is needed acutely
  - Intraperitoneal potassium supplementation for K < 4.0
  - Dose and PD intensity not well studied
  - Antibiotic and medication dosing not well studied (consider CRRT literature)

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<thead>
<tr>
<th>Table 2. High-volume peritoneal dialysis prescription and adequacy</th>
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<tbody>
<tr>
<td>Variables</td>
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<tr>
<td>Dialysate volume per cycle (ml)</td>
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<tr>
<td>Inflow time (minute)</td>
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<tr>
<td>Dwell time (minute)</td>
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<tr>
<td>Outflow time (minute)</td>
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<tr>
<td>Cycle duration (minute)</td>
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<tr>
<td>Total exchanges per session</td>
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<tr>
<td>Session duration (hours)</td>
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<tr>
<td>Total dialysate volume per session (L)</td>
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<tr>
<td>Glucose (%)</td>
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<tr>
<td>Prescribed Kt/V per session weekly</td>
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<tr>
<td>Delivered Kt/V per session weekly</td>
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*Without significant difference from prescribed Kt/V.

Take Home Points and Final Thoughts

- PD for AKI requires a team approach, a culture change and “buy in” for all of the care team and is feasible with acceptable outcomes
- PD access insertion reliability and speed is key as is nursing expertise.
- Need to develop and implement a standardized protocol
- Consider initial candidates carefully and more restrictively
  - Baby steps if you have an urgent start PD program or start one first
  - Lower leak risk candidates
  - As a bridge from acute hemodialysis for longer to recover AKI
  - Non-ventilated patients
  - Stop if you are not achieving your goals after 2-3 days
Questions

DARLENE RODGERS, BSN, RN, CNN, CPHQ
Nurse Consultant
American Society of Nephrology (ASN)

Closing Remarks

TALAT ALP IKIZLER, MD, FASN
Vanderbilt University Medical Center
COVID-19 is common in hospitalized patients kidney disease and can lead to devastating outcomes with up to 30% mortality.

In addition to being prepared, we have to be creative and think out of the box at times.

We should use our inherent expertise and knowledge to manage these patients.

However, overzealous use of resources is not recommended.

In times of crises, efficient and timely communication and collaboration is key to success.