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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Montefiore Medical Center and Albert Einstein College of Medicine
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

Rising Toll
Confirmed Covid-19 Cases in New York City

Deaths per 100,000, by borough

Bronx
Queens
Staten Island
Brooklyn
Manhattan

Note: Data as of 9:30 a.m. March 31
Source: NYC's Health Department

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>
</tr>
</thead>
<tbody>
<tr>
<td>Affected geographical areas</td>
<td>2</td>
<td>82</td>
<td>1,024</td>
<td>47,413</td>
</tr>
<tr>
<td>International travel to affected geographic areas within 14 days</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- China</td>
<td></td>
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<tr>
<td>- Iran</td>
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<tr>
<td>- Italy</td>
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<td>- Japan</td>
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<tr>
<td>- South Korea</td>
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<tr>
<td>National geographical areas</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>- New Rochelle and New York City</td>
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</tr>
<tr>
<td>- Washington State</td>
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</tr>
<tr>
<td>Global spread</td>
<td></td>
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<tr>
<td>Now largely community transmission without known exposure</td>
<td></td>
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</tbody>
</table>
Limited testing capability

SARS-CoV-2 Final Verified Test Results – MMC

Montefiore Medical Center COVID-19 + Daily Census
Positive Cases Currently Admitted
**MANAGEMENT OF ESKD COVID PATIENTS IN ED**

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

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Mokrzycki MH and Coco M. Kidney 360, March 2020
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
CHALLENGES DURING COVID CRISIS

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>
</tr>
</thead>
<tbody>
<tr>
<td>HD off units</td>
<td>~8-12</td>
<td>~18-25</td>
</tr>
<tr>
<td>Acute PD</td>
<td>0</td>
<td>~8-9</td>
</tr>
</tbody>
</table>

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 2 x 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

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
AVAILABLE MACHINES IN US FOR CRRT

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
• 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

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>
</tr>
</thead>
<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>83</td>
</tr>
<tr>
<td>Duration of treatment (days)</td>
<td>5.5±2.7</td>
</tr>
<tr>
<td>Resolution of acute kidney injury (%)</td>
<td>73±26</td>
</tr>
</tbody>
</table>

ASN

Gabriel et al. Kidney Int 2008 73, s87-93
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)

Table 2. High-volume peritoneal dialysis prescription and adequacy

<table>
<thead>
<tr>
<th>Variables</th>
<th>Measurement</th>
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</thead>
<tbody>
<tr>
<td>Dialysate volume per cycle (ml)</td>
<td>2000</td>
</tr>
<tr>
<td>Dwell time (minute)</td>
<td>10-60</td>
</tr>
<tr>
<td>Outflow time (minute)</td>
<td>20</td>
</tr>
<tr>
<td>Cycle duration (minute)</td>
<td>60-90</td>
</tr>
<tr>
<td>Total exchanges per session</td>
<td>16-22</td>
</tr>
<tr>
<td>Session duration (hours)</td>
<td>24</td>
</tr>
<tr>
<td>Total dialysate volume per session (L)</td>
<td>30-44</td>
</tr>
<tr>
<td>Glucose (%)</td>
<td>1.5-4.25</td>
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<tr>
<td>Prescribed Kt/V per session</td>
<td>0.6</td>
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<tr>
<td>weekly</td>
<td>4.2</td>
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<tr>
<td>Delivered Kt/V per session</td>
<td>0.91±0.11*</td>
</tr>
<tr>
<td>weekly</td>
<td>3.5±0.68*</td>
</tr>
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</table>

*Without significant differences 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.