

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



1



Welcome and Opening Statement

ALAN KLIGER, MD

Clinical Professor of Medicine

Yale School of Medicine



2



Report from the Front Lines

MICHELE H. MOKRZYCKI, MD, MS

Professor of Medicine

Division of Nephrology

Montefiore Medical Center and Albert Einstein College of Medicine

Bronx, New York



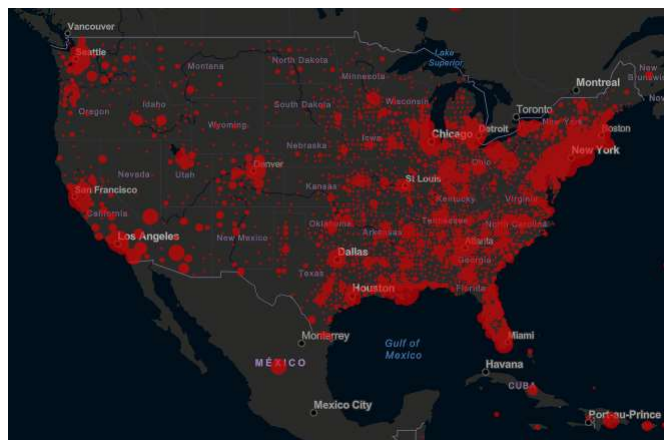
3



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

Confirmed Cases
236,339

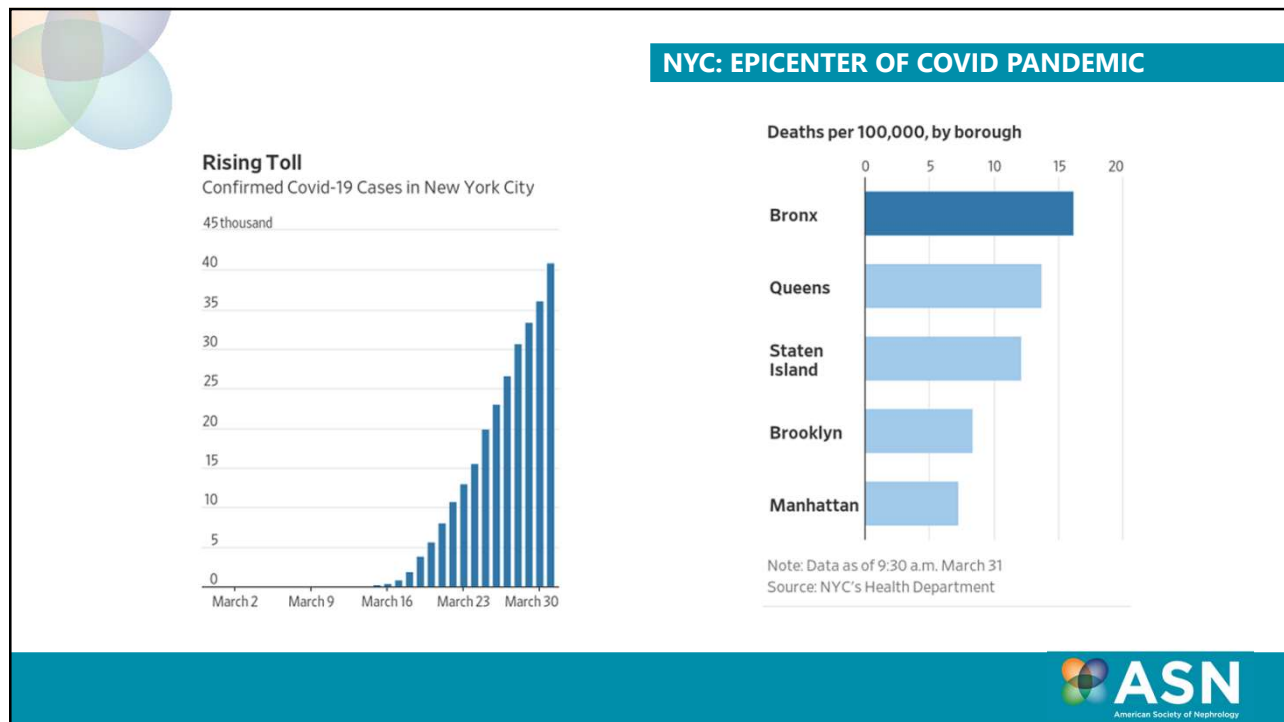
Deaths
4,906



<https://gisanddata.maps.arcgis.com>



4



5

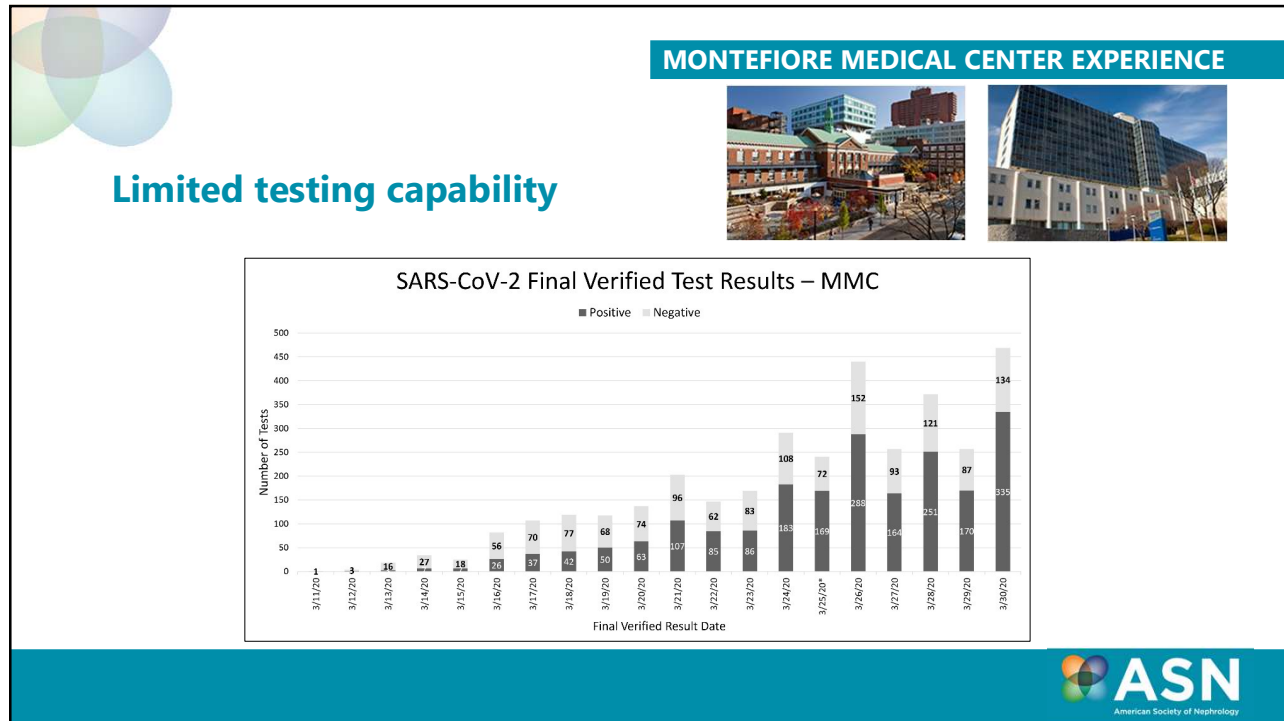
NYC/WESTCHESTER TIMELINE MARCH 2020

	March 3, 2020	March 7, 2020	March 17, 2020	March 31, 2020
All COVID-19 confirmed patients in Westchester and New York City	2	82	1,024	47,413
Affected geographical areas	International travel to affected geographic areas within 14 days <ul style="list-style-type: none"> China Iran Italy Japan South Korea 	National geographical areas <ul style="list-style-type: none"> New Rochelle and New York City Washington State 	Global spread Now largely community transmission without known exposure	

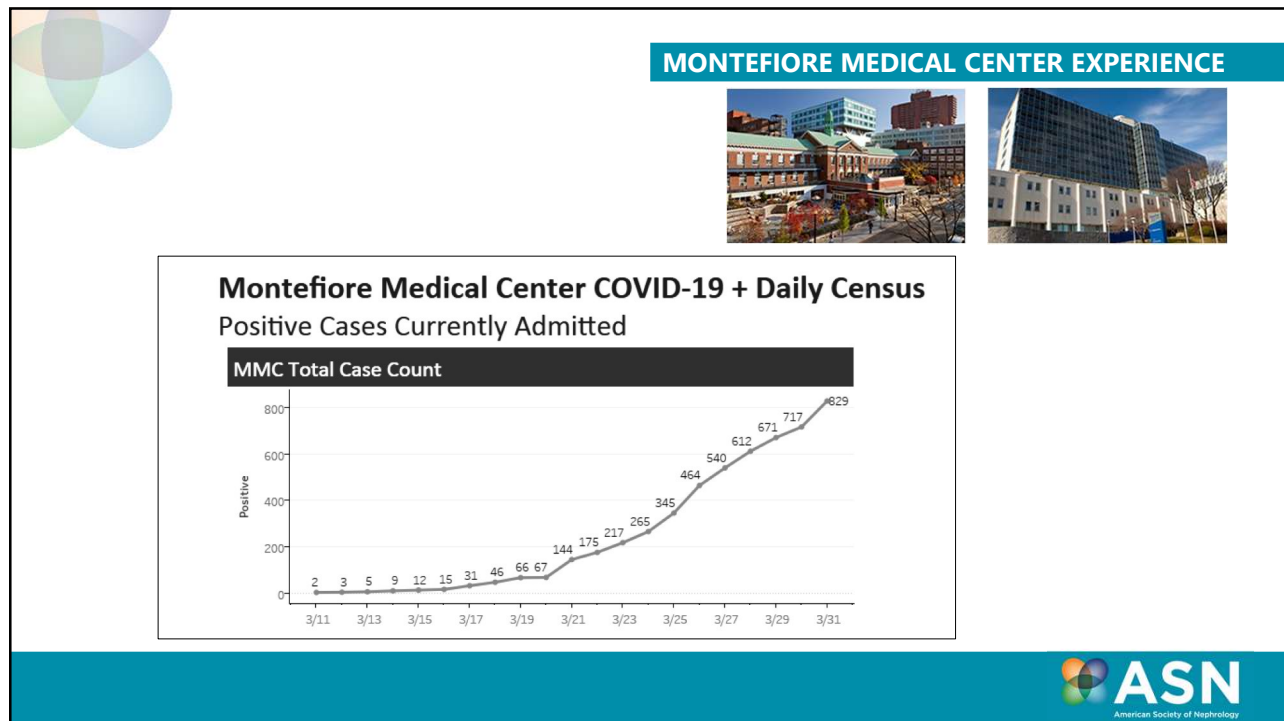
Mokrzycki MH and Coco M. Kidney 360 March 2020

ASN
American Society of Nephrology

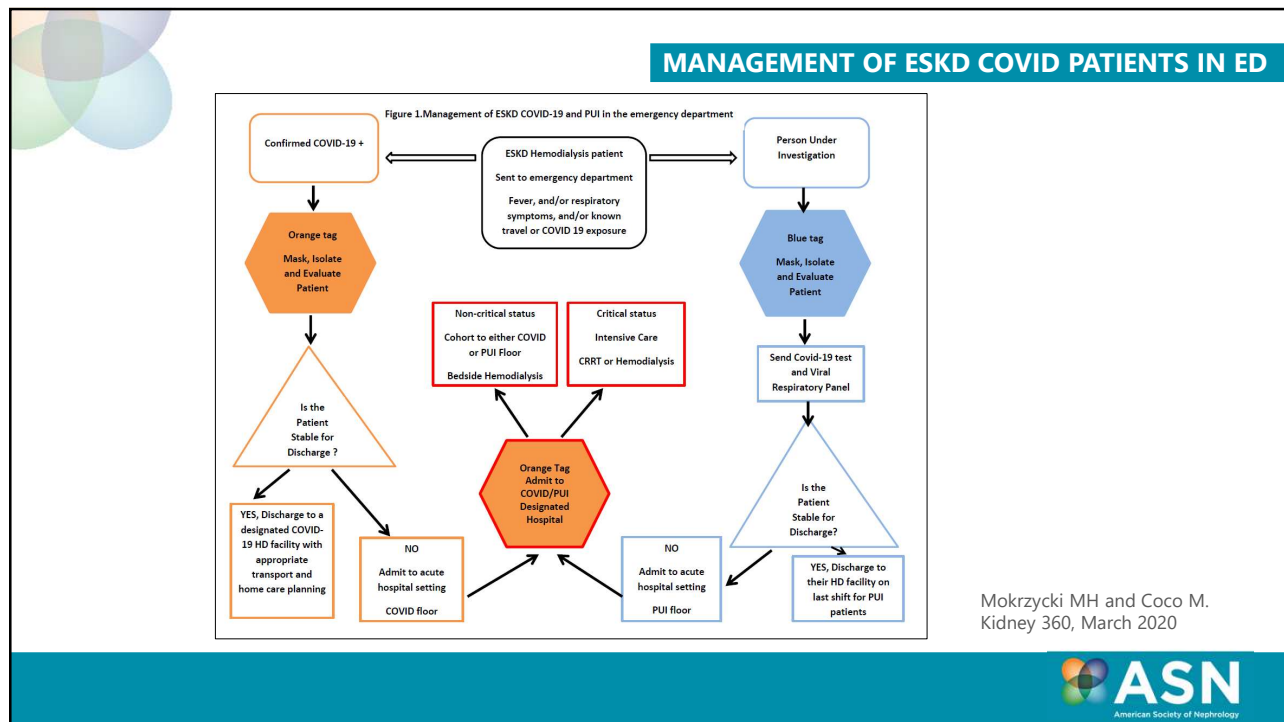
6



7



8



9

MONTEFIORE MEDICAL CENTER, BRONX NY


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

ASN
American Society of Nephrology

10




MONTEFIORE MEDICAL CENTER, BRONX NY

Nephrology Transplant Service: Hospitalized patients COVID+ Census for March

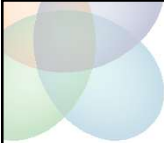
- **Renal transplant patients:**
 - 24 patients
 - 78% male
 - Discharged 33%
 - Deaths 17%*

*limited follow up available

Data provided by Enver Akalin MD



11



INPATIENT HEMODIALYSIS FOR COVID + PTS


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



12

INPATIENT HEMODIALYSIS FOR COVID + PTS

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



13

INPATIENT HEMODIALYSIS FOR COVID + PTS

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



14

CHALLENGES DURING COVID CRISIS

Increasing nursing staffing for 1:1 treatments and staff shortages due to illness or quarantine

Census	Jan/Feb	Late March	
HD off units	~8-12	~18-25	*2-3 fold increase in HD nursing staffing
Acute PD	0	~8-9	* Increase in level of care required of floor nursing

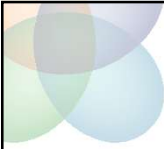
15

INPATIENT HEMODIALYSIS FOR COVID + PTS

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 cyclor PD equipment
 - Conserves nursing time and reduces staff exposure
 - Conserves on the use of PPE
- Palliative care consultation where appropriate


16



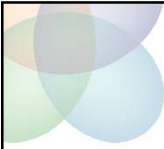
HOSPITAL RESOURCES

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




17



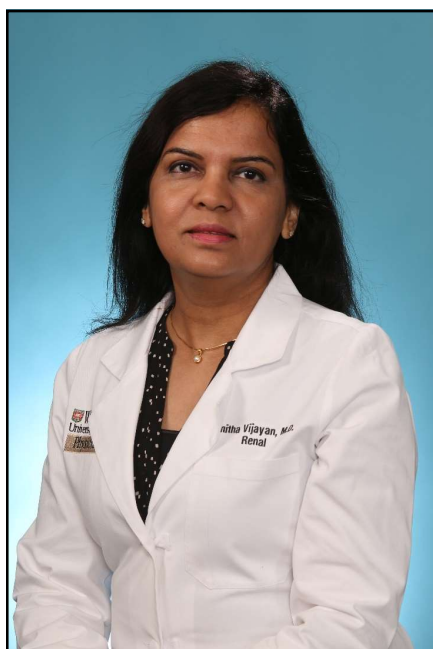
EXTERNAL COMMUNICATION

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



18



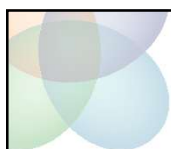
Practical Aspects of RRT In Hospitalized Patients With COVID-19 With AKI or ESKD

ANITHA VIJAYAN, MD, FASN

Washington University in St. Louis, MO



19

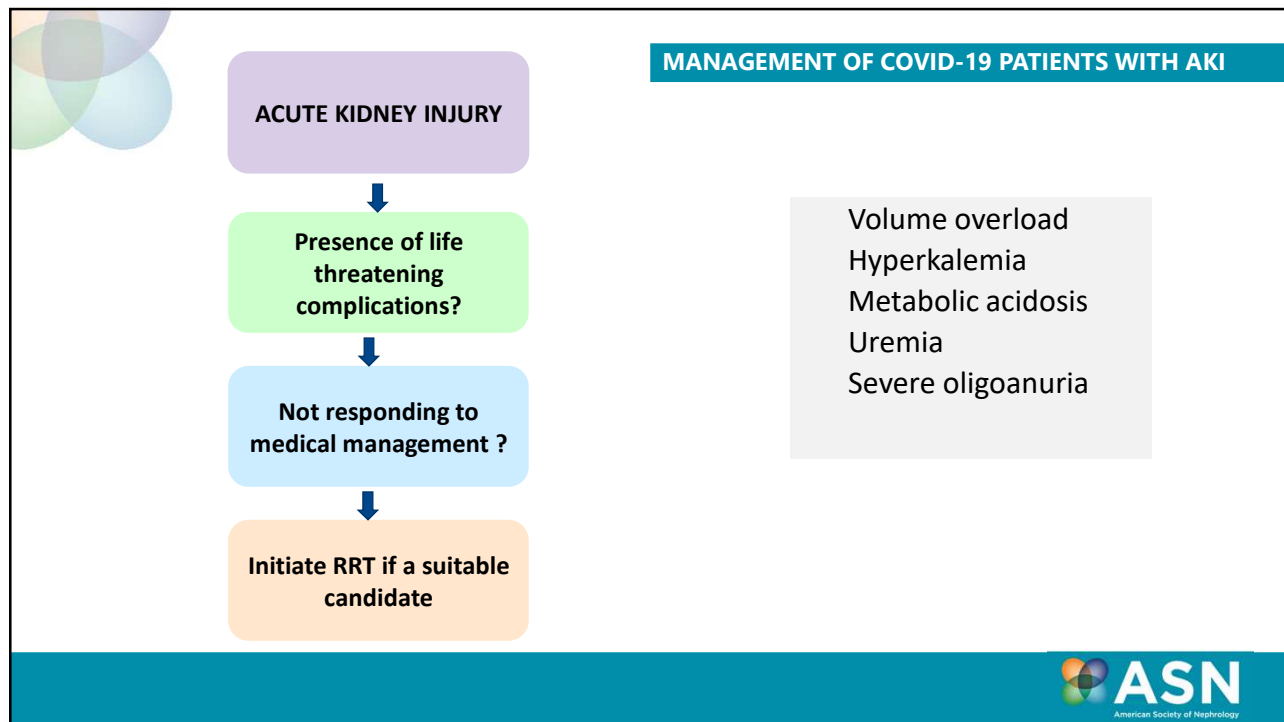


Disclosure

- NxStage – Critical Care Advisory Board Member



20



21

MANAGEMENT OF COVID-19 PATIENTS WITH AKI

Indications to start RRT

- Volume overload/Respiratory failure
- Hyperkalemia
- Metabolic acidosis
- Uremia
- Severe oligoanuria

BE WARY OF AGGRESSIVE FLUID RESUSCITATION

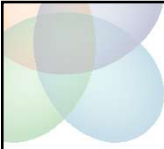
BALANCED CRYSTALLOIDS

TRIAL OF HIGH DOSE LOOP DIURETICS

NO DATA TO SUPPORT EARLY INITIATION OF RRT IN COVID PATIENTS


ASN
American Society of Nephrology

22

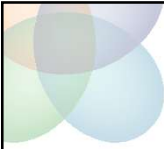


MODALITIES OF RRT

- **CRRT**
 - CVVH
 - CVVHD
 - CVVHDF
- **PIRRT (prolonged intermittent renal replacement therapy)**
 - Various terminologies – SLED, AVVH, (Others)
- **Intermittent HD**



23




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




24



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




25

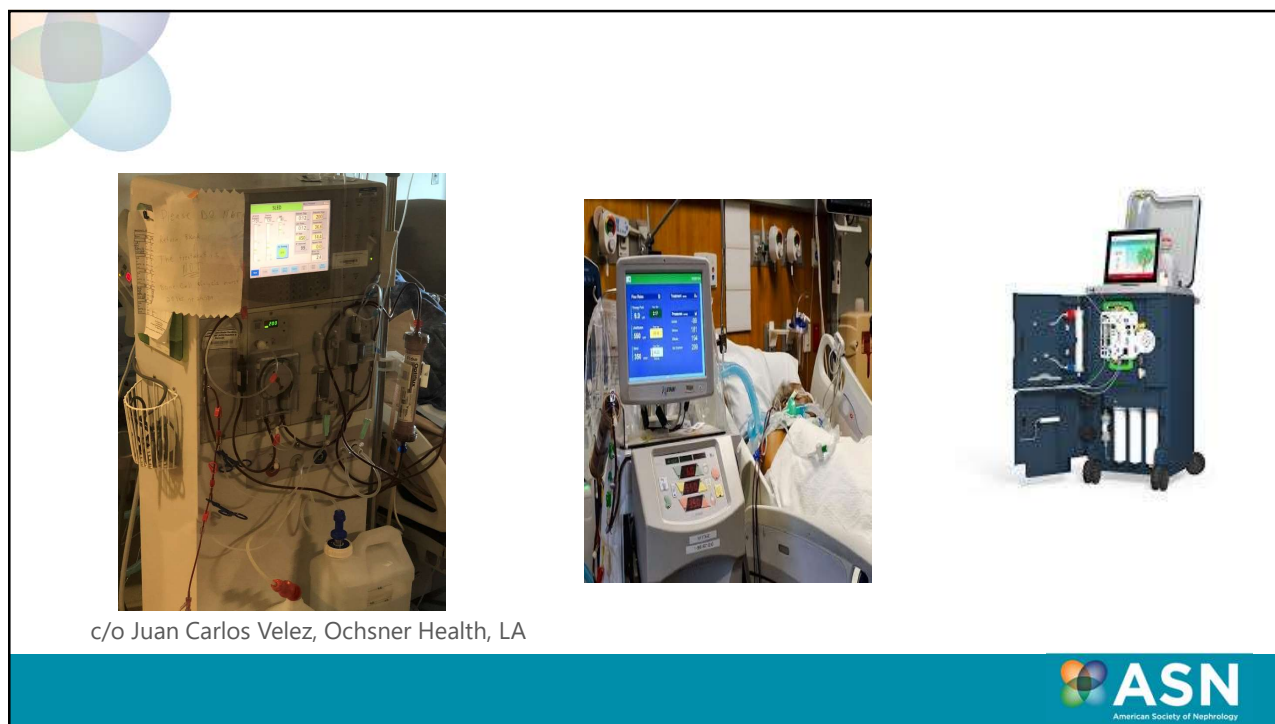
PIRRT

- 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**

Edrees F, Li T, Vijayan A. PIRRT. Adv Chronic Kidney Dis 2016; 23:195.



26



27

PIRRT WITH CRRT EQUIPMENT

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

Edrees F, Li T, Vijayan A. PIRRT. Adv Chronic Kidney Dis 2016; 23:195.

ASN
American Society of Nephrology

28

PIRRT WITH HD EQUIPMENT

SLED PRESCRIPTION

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



29

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**

Ashita J. Tolwani Keith M. Wille, Seminars in Dialysis, 2009
Morabiot, Pistolesi, Tritape, Fiaccadori, CJASN 2014




30

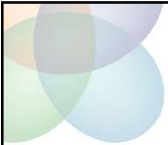


☐ Heparin to infuse via CVVHDF machine. Heparin sodium infusion (1000units/mL) at 1000units/hour via CRRT circuit.

Adjust heparin based on the following nomogram:	
Discontinue previous heparin and LMWH orders	
Do not use heparin if suspected or proven HIT	
less than 41 seconds	increase infusion rate by 200units/hour equals 0.2mL/hour
41-60 seconds	increase infusion rate by 100units/hour equals 0.1mL/hour
61-80 seconds	no change
81-90 seconds	decrease infusion rate by 100units/hour equals 0.1mL/hour
91-100 seconds	stop infusion for 30 minutes, then decrease infusion rate by 200units/hour equals 0.2mL/hour
greater than 100 seconds	stop infusion for 1 hour, then decrease by 300units/hour equals 0.3mL/hour
If two consecutive aPTTs greater than 100	stop infusion and call ICU physician



31




INTERMITTENT HEMODIALYSIS

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



32

HEMODIALYSIS VASCULAR ACCESS

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



33

HEMODIALYSIS VASCULAR ACCESS

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

Al Rifai A, Sukul N, Wonnacott R, Heung M, Hemodial Int. 2018 Jan;22(1):50-55 .



34

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?**



35

Managing resources

- **Cross training on setting up/monitoring RRT equipment**
 - Nephrologists
 - Other nurses



36

CRRT AND PIRRT

Creative CRRT/PIRRT maneuvers during pandemic

- Minimize exposure to nurses and physicians
- Conserve PPE

PATIENT SAFETY FIRST



37



c/o Ashita Tolwani MD, UAB, AL

38



c/o Sadaf Sheikh MD, St. Louis, MO

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

RRT IN AKI/ESKD PATIENTS WITH COVID-19



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



41



Peritoneal Dialysis For The Treatment of Acute Kidney Injury

JEFFREY PERL, MD, SM FRCP (C)

Associate Professor of Medicine, University of Toronto

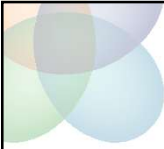
Division of Nephrology St. Michael's Hospital

ASN COVID-19 Response Team and Home Dialysis Subcommittee

@PD_Perls



42




PD FOR ACUTE KIDNEY INJURY

Peritoneal Dialysis (PD) Was Initially Used for Acute Kidney Injury (AKI)

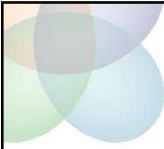
• **TREATMENT OF UREMIA AFTER ACUTE RENAL FAILURE BY PERITONEAL IRRIGATION**

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

JAMA 1946; 130(11):703–5





43



PD FOR ACUTE KIDNEY INJURY

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 cyclor

44

PD FOR ACUTE KIDNEY INJURY

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



45

PD FOR ACUTE KIDNEY INJURY

High volume PD vs. Daily HD for AKI

120 patients randomized to High Volume PD vs. Daily Hemodialysis

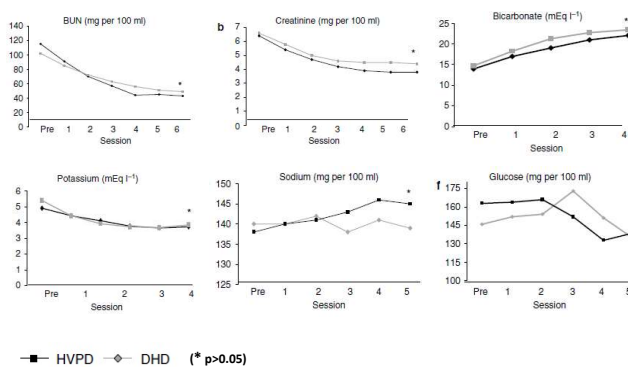


Table 2 | Outcomes according to treatment group

	HVPD (n=60)	DHD (n=60)	P-value
Mortality (%)	58	53	0.71
Recovery of kidney function (%)	83	77	0.84
Duration of treatment (days)	5.5 ± 2.7	7.5 ± 3.1	0.02
Resolution of acute kidney injury (days)	7.2 ± 2.6	10.6 ± 4.7	0.04

DHD, daily hemodialysis; HVPD, high volume peritoneal dialysis.
 Recovery and resolution of kidney function of survivors.

46

PD FOR ACUTE KIDNEY INJURY

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?



47

PD FOR ACUTE KIDNEY INJURY

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



48

PD FOR ACUTE KIDNEY INJURY

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

Variables	Measurement
Dialysate volume per cycle (ml)	2000
Inflow time (minute)	10
Dwell time (minute)	30–60
Outflow time (minute)	20
Cycle duration (minute)	60–90
Total exchanges per session	16–22
Session duration (hours)	24
Total dialysate volume per session (L)	32–44
Glucose (%)	1.5–4.25
Prescribed Kt/V per session weekly	0.6 4.2
Delivered Kt/V per session weekly	0.51 ± 0.1^a 3.5 ± 0.68^a

^aWithout significant difference from prescribed Kt/V.

Ponce et al Clin J Am Soc Nephrol 7: 887–894, June, 2012

49

PD FOR ACUTE KIDNEY INJURY

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

Northwestern Medicine
Vikram Aggarwal

Vesh Srivitana
Weill Cornell Medical College
Rogovin Institute

50



Questions

DARLENE RODGERS, BSN, RN, CNN, CPHQ

Nurse Consultant

American Society of Nephrology (ASN)



51



Closing Remarks

TALAT ALP IKIZLER, MD, FASN

Vanderbilt University Medical Center



52



SUMMARY POINTS

- 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.