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Managing Acute Kidney Injury (AKI) in the Setting of the COVID-19 Patient Surge

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COLLEGE OF POPULATION HEALTH

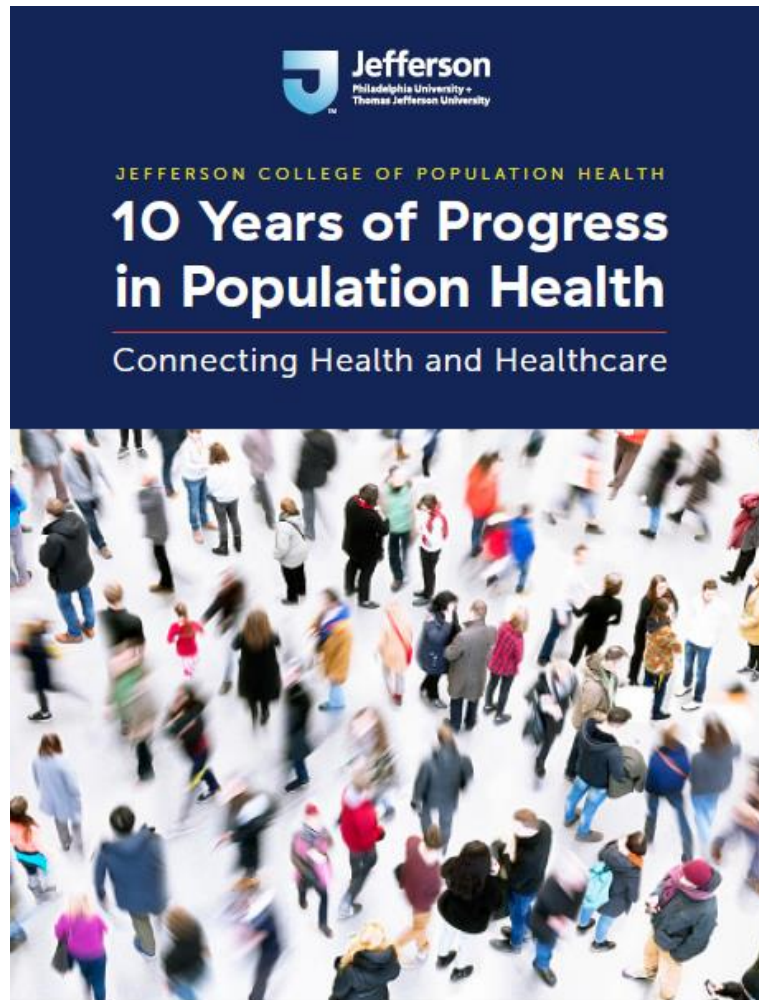
Spread the Science, NOT the Virus
Clinical Lessons from the Northeast Surge



Jefferson
Thomas Jefferson University

July 21, 2020 | 4:00-5:30 pm ET

Jefferson College of Population Health



Managing Acute Kidney Injury (AKI) in the Setting of the COVID-19 Patient Surge

Presented by:



Lorraine Ryan, Esq, Senior Vice President, Legal, Regulatory, &
Professional Affairs

Durward Rackleff, Senior Director, Quality & Patient Safety

Today's Moderator

- Dr. Renee Garrick, New York Medical College-Westchester Medical Center

Today's Panelists

- Dr. Alan Kliger, Yale School of Medicine
- Dr. Leslie Wong, The Cleveland Clinic
- Dr. David Chartyan, NYU Langone Health
- Dr. George Coritsidis, NYC Health+Hospitals/Elmhurst
- Dr. Jeffrey Silberzweig, NewYork-Presbyterian Hospital
- Dr. Savneek Chugh, New York Medical-Westchester Medical Center

DISCLOSURES

RENEE GARRICK, MD, FACP, FASN

Professor Clinical Medicine, Chief Medical Officer and Vice Dean,
New York Medical College, Westchester Medical Center



Interests and Relationships:

Chair, Human Factor Subcommittee NTDS

Renal Physicians Association

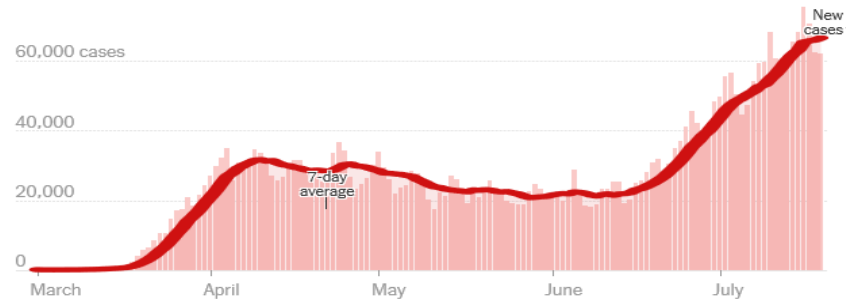
American Society of Nephrology

Medical Director DCI, INC Hawthorne, Hawthorne, NY

SPREAD THE SCIENCE NOT THE VIRUS:CLINICAL LESSONS FROM THE NORTHEAST SURGE

- Between early March and July 18th 2020 approximately 406,807 New Yorkers have tested positive for COVID-19 (5,115,470 have had testing) (7.9% positivity rate overall) 48.7% are female.
- In New York as of July 18th there have been 25,056 deaths (overall 6.16 % fatality rate) (42% of fatalities are female)
- Of these fatalities 90% have has at least ONE CO-MORBIDITY
- Major Co-Morbidities are:
 - Hypertension (53%)
 - Diabetes (35%)
 - Dyslipidemia (21%)
 - Dementia (13.5%)
 - CAD (11.7%)
 - CKD (10.4 %)

New reported cases by day in the United States



Note: The seven-day average is the average of a day and the previous six days of data.



ALAN S. KLIGER, MD



NTDS Project Chair; COVID-19 Response Team Co-Chair

Yale School of Medicine

- **Consultancy Agreements:** ASN; National Institutes of Diabetes, Digestive Diseases and the Kidney
- **Honoraria:** several universities and medical schools, professional organizations - honoraria for lectures, seminars, webinars;
- **Scientific Advisor or Membership:** Qualidigm (Quality Improvement Organization);
- **Other Interests/Relationships:** Renal Physicians Association; American Society of Nephrology

28-day case fatality rate Dialysis patients

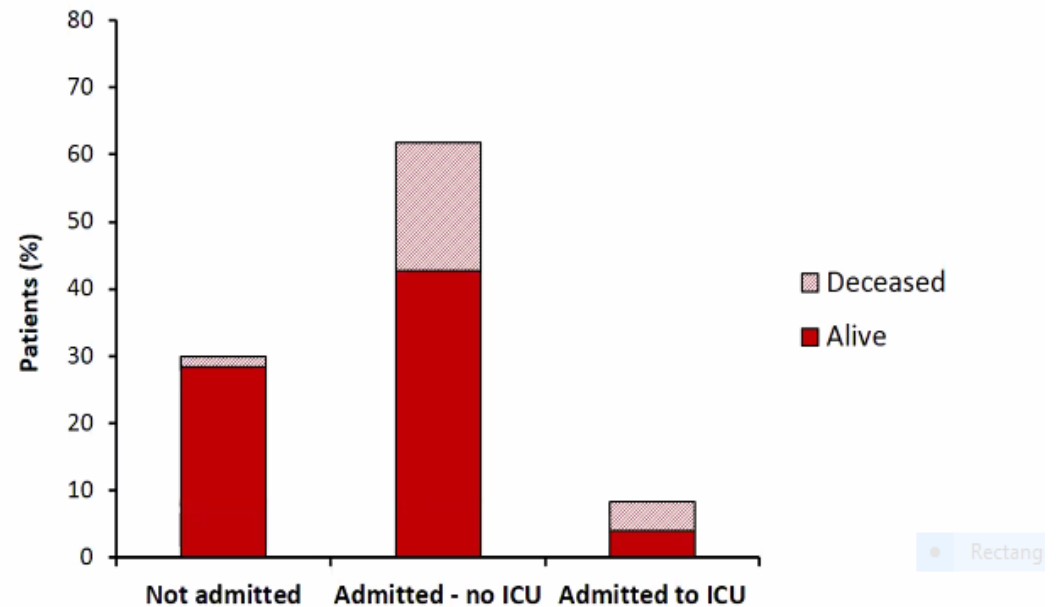
All patients: 25%

Not admitted patients: 5%

Hospitalized patients: 33%

Patients admitted to ICU: 53%

Survival according to admission status





Kidney-related outcomes and underlying disease among COVID-19 patient cohorts in the US, January to May 2020



SHANNON NOVOSAD, MD, MPH

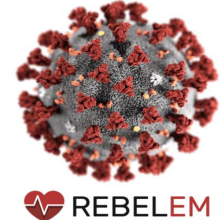
	US (n= 11)
AKI in hospitalized patients, n/N (%)	4747/15154 (31.3%)
Range across cohorts	18.9%-69.0%
AKI in ICU patients, n/N (%)	2352/4244 (55.4%)
Range across cohorts	31.6%-100%
RRT in hospitalized patients, n/N (%)	987/15546 (6.3%)
Range across cohorts	4.8%-15.4%
RRT in ICU patients, n/N (%)	386/2304 (16.8%)
Range across cohorts	11.3%-51.4%
CKD in hospitalized patients, n/N (%)	1558/15131 (10.3%)
Range across cohorts	5.0%-38.0%



Lessons Learned: Outpatient Dialysis

- Come to dialysis
- Call in ahead of your treatment if you are have fever, cough, etc.
- Protect yourself at home: face covering, social distancing, hand washing
- If you are sick: don't just tough it out at home: call your doctor. Come to hospital
- Hemodialysis facility lessons
 - Transportation: anticipate and educate
 - Segregate proven COVID-19 and PUI
 - Screen patients and staff every shift: questions, temp
 - No waiting rooms
 - Mental health resources
 - Prepare for the long haul (staff shortages, staff health, PPE)

COVID-19: Screening, Testing, PUI, and Returning to Work



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CDC: Return to Outpatient Dialysis (July 2020)

No Test-Based Strategy for Discontinuing Transmission-Based Precautions

Symptom-Based Strategy for Discontinuing Transmission-Based Precautions.

Patients with [mild to moderate illness](#) who are not severely immunocompromised:

At least 10 days have passed *since symptoms first appeared* **and**

At least 24 hours have passed *since last fever* without the use of fever-reducing medications **and**

Symptoms (e.g., cough, shortness of breath) have improved

Note: For patients who are **not severely immunocompromised¹** and who were **asymptomatic** throughout their infection, Transmission-Based Precautions may be discontinued when at least 10 days have passed since the date of their first positive viral diagnostic test.

Patients with [severe to critical illness](#) or who are severely immunocompromised¹:

At least 20 days have passed *since symptoms first appeared* **and**

At least 24 hours have passed *since last fever* without the use of fever-reducing medications **and**

Symptoms (e.g., cough, shortness of breath) have improved



New York City Acute Dialysis Snapshot

April 16-21, 2020

NYC DATA COLLECTION

	Facility A	Facility B	Facility C	Facility D	Facility E	Facility F	Facility G
# ICU Beds Pre-COVID-19	99	Data Not Available	Data Not Available	72	114	253	414
# ICU Beds Mid COVID-19	243	35	376	144	260	433	800
% Increase in # of ICU Beds	145.45%	---	---	100.0%	128.07%	71.15%	93.23%
% ICU Patients COVID-19 +	92.5%	57.1%	100%	79.7%	92.3%	97.4%	91.3%
% ICU COVID-19 + Patients on RRT	27.1%	65.0%	23.7%	56.2%	27.1%	19.5%	30.5%

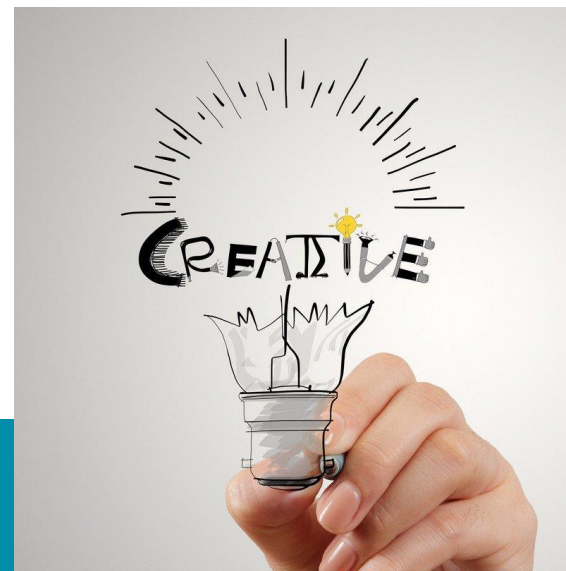
New York City Dialysis Community Audit
Data Collection Period: April 16- 21, 2020



ASN Analysis of 7 Hospital Systems, Greater NY

- At the height of the COVID-19 pandemic in NYC, many hospital systems feared they did not have enough CRRT fluids.
- Needs for CRRT and other RRT were “burning through” up to 5 times the usual supply of fluids, cartridges, other supplies
- Staffing shortages threatened to limit ability to deliver RRT
 - More ICU nurses, dialysis nurses and technicians were needed
 - ICU nurses, dialysis nurses and technicians were falling ill and numbers fell

- Wide variation in actual CRRT fluid used (30-70 liters/patient/day); due to the impending fluid shortages
- Teams were creative in seeking alternative RRT therapies
 - Reducing the volume of CRRT fluid delivered/patient
 - Using intermittent rather than continuous treatments'
 - Utilizing intermittent hemodialysis, sustained low efficiency dialysis (SLED), or acute peritoneal dialysis for many patients



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

Dr. Michele Mokrzycki, Montefiore Medical Center, Bronx, NY

- 2 of the 7 hospitals actually had fluid shortages of between 3,000 and 9,000 liters for the week
- 5 of 7 had ideal fluid need shortages of between 1,000 and 31,000 liters were they to use 70L/pt/day for CRRT.
- 2 of 7 had ideal fluid need shortages were they to use 60L/pt/day for CRRT
- Conservation of dialysis fluids and equipment have to be closely balanced with patient safety



Where are we now?

- Most hospitals now have sufficient PPE
- Hospital beds and ICUs are filling up in new hotspots: Phoenix, Houston, Miami
- ICU utilization appears lower than March-April in NY
- AKI and RRT appear less prevalent than in March-April in NY
- Staffing remains a challenge



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Right time PD in Covid-19, not running of time PD

Leslie P. Wong, MD, MBA

Chief Medical Officer, Nephrology Care Alliance

Chair, Quality Improvement and Education, ASN-NTDS

Staff Nephrologist, Cleveland Clinic

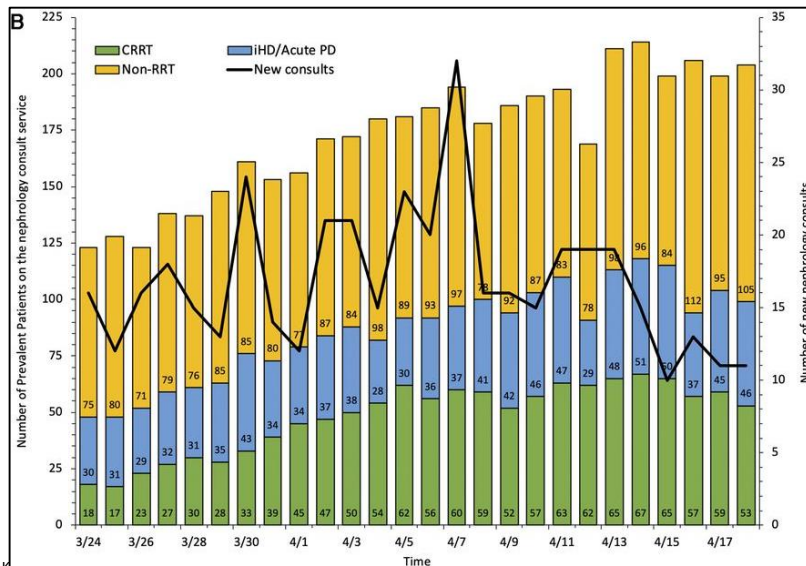
Disclosures

- Employee of Nephrology Care Alliance and Cleveland Clinic
- My presentation and opinions are my own and do not represent the view or position of my employers, nor should they be treated as specific medical advice

Consideration #1: Resource (and nephrologist) stress at all levels

20-25% ventilated Covid-19 patients require RRT in reports across Europe and the U.S.¹

Machine, supply chain, and staffing shortages force rationing of RRT services.



¹ ISN-ISPD AKI Report, May 6, 2020

Table 1. Columbia University Division of Nephrology Clinical Services at baseline and during the pandemic surge

Service	Usual (April 2019)	Surge (April 2020)
Number of ICU hospital beds	139	312
Number of nephrology clinical services	6	9
Total inpatient hemodialysis treatments	911	1114
Total inpatient hemodialysis unit treatments	741	738
Total inpatient hemodialysis bedside treatments	170	376
Hemodialysis bedside/total treatments (%)	23	51
CRRT cases per day	<24	67 (peak)
Acute peritoneal dialysis cases per day	0	7

Table 2. CUIMC dialysis capacity at baseline and during the pandemic surge

Service	Baseline	Anticipated Surge Needs	Actual Surge Resources
Total hemodialysis machines	25	40	28
Total hemodialysis nurses	34	48	37
Hemodialysis unit nursing staffing ratio	1:2	1:2	1:3
Bedside hemodialysis nursing staffing ratio	1:1	1:1	1:1
CRRT machines	27	73	50 (peak)

Consideration #2: Is PD a solution for AKI in Covid-19?

Less infrastructure/cost, simplicity¹

Not enough cyclers or PD nurses!

More gradual solute and fluid removal¹

ARDS and cytokine storm!

No anticoagulation and avoidance of BSI¹

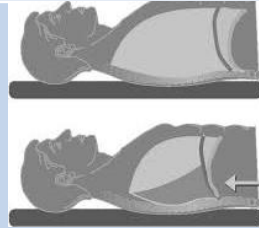
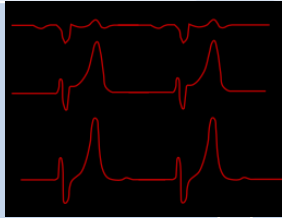
No benefit if no PD catheter!

Little or no difference in mortality¹

That was in Brazil!

¹Cochrane Database Syst Rev. 2017 Dec 4;12:CD011457.

Consideration #3: Common concerns about PD in AKI



Severe hyperkalemia, lactic acidosis, and inadequate solute clearance

Inability to control or achieve adequate fluid control

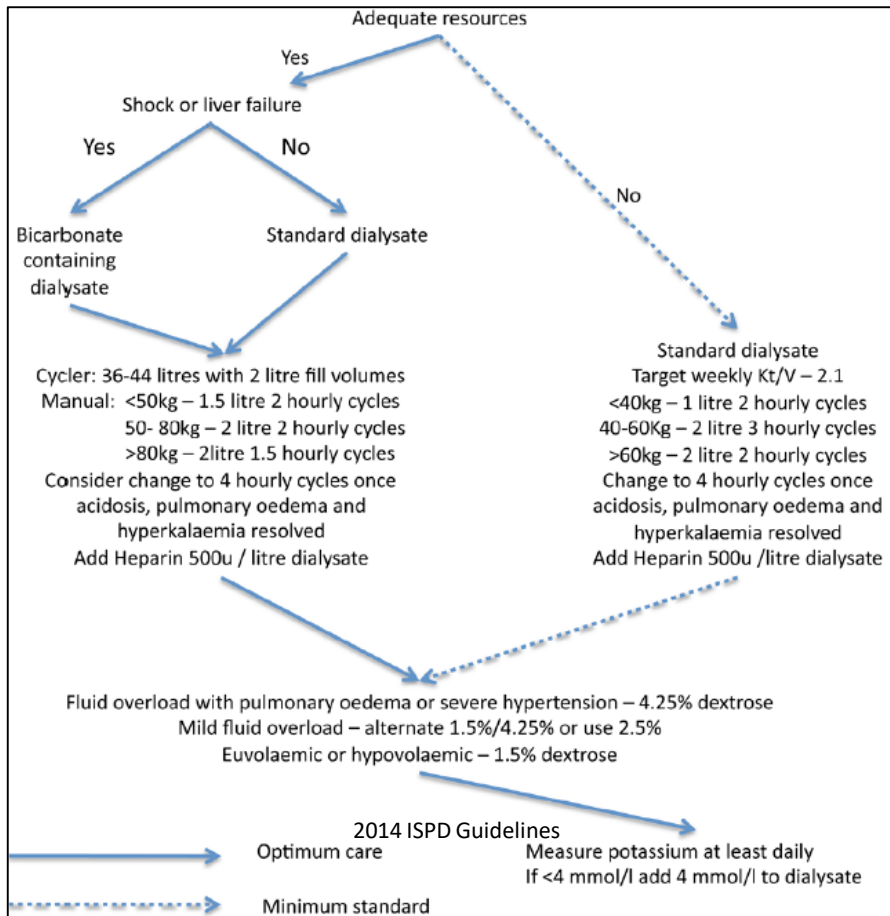
Altered respiratory dynamics by increased intraperitoneal pressure

Unavailability of timely PD catheter placement and flow related dysfunction

Peritonitis, exit-site infections, and dialysate leaks

Concerns are magnified by lack of experience in U.S. ICU settings

Consideration #4: Acute PD isn't the same as urgent start PD



- Urgent start PD is usually 6-8L/d
- Acute PD studies used 36-44L/d
- AKI in the ICU is not new ESKD
- During initial 24 hours, short cycle times may be needed to more rapidly achieve solute/fluid targets
- Solution and cycler supply stress?

Sample protocol: ISPD 2020 AKI Guidelines

Patient weight	Fill volumes	Cycle length	Exchanges over 24h
< 60kg	1.5L	120 min	12
60-80kg	2L	120 min	12
80-100kg	2L	90 min	16

- Much simplified protocol
- This regimen is continued until the patients acute RRT indications are stabilized
- 2.5% and 4.25% solutions used depending on UF needs

Sample protocol: King's College, U.K.



King's Kidney Care

King's College Hospital NHS Foundation Trust

Acute Peritoneal Dialysis on Intensive Care
Units protocol

17th April 2020

Elaine Bowes, Senior Clinical Nurse Specialist

Hugh Cairns, Consultant Nephrologist

Claire Sharpe, Consultant Nephrologist

The plan below is for guidance but may need to be adjusted according to the patient's fluid status, metabolic dysfunction and ventilation status. All patients should be reviewed by a nephrologist daily and the prescription altered as necessary.

Session 1

Therapy: Tidal 90% or
CCPD / IPD (NO TIDAL)
Time: 12 - 18 hours
Total Vol: 20,000mls TO
30,000mls
Fill Vol: 1200- 1600mls(
no leaks in ITU
Last Fill: 0mls
Cycles: between 9 -14
Dwell Time: approx. 20-
39mins 9 Patient specific
Select Dextrose strength

Session 2

Therapy: CCPD/IPD
Time: 16 hours
Total Vol: 20,000mls-
30,000mls
Fill Vol: 1500- 2000mls
Last Fill: 0mls
Cycles: 9 to 20
Dwell Time: 20 mins to
1:15

Session 3

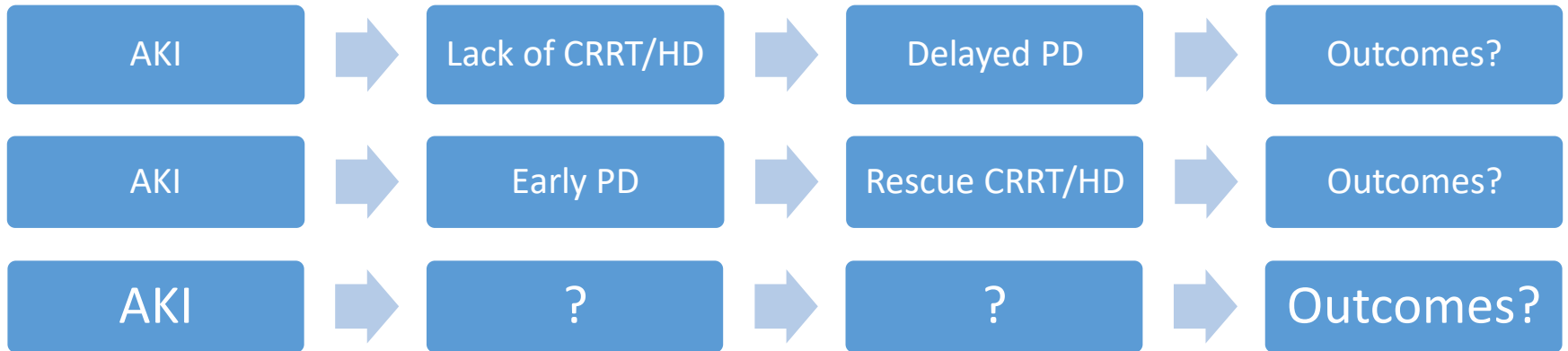
Therapy: CCPD/IPD
Or
Therapy: CCPD/IPD
(dependent on drain pain)
Time: 12 TO 16
hours
Total Vol: 15,000 to
25,000mls
Fill Vol: 1.5l to 2.5 l
Last Fill: 1000 to
1500mls
Dextrose: Different
(Extraneal)

<https://renal.org/wp-content/uploads/2020/04/KCH-Renal-Covid-Acute-PD-on-ICU-protocol-final.pdf>

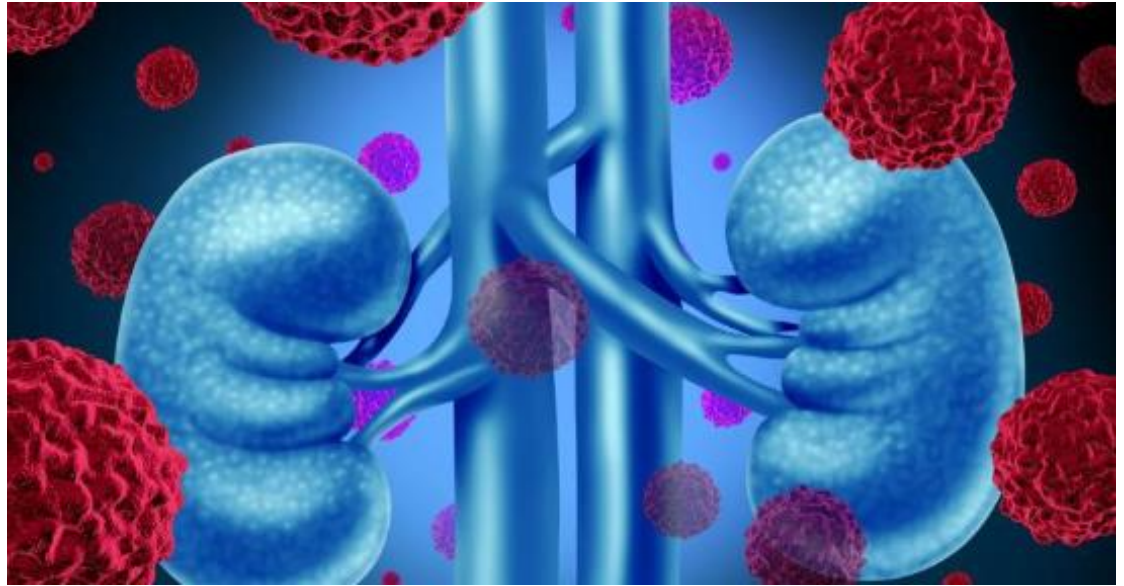
Consideration #5:

Right time versus running out of time modality?

ARDS management	Fluid removal	Solute control	Timing of initiation	Placing access	Education
?	?	?	?	?	?



Treatment of Kidney Disease During the COVID-19 Pandemic



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Disclosures

- Research funding
 - NIDDK, NHLBI, Medtronic,
 - Gilead, Amgen (pending), Novo Nordisk
- Consulting
 - Medtronic, Lilly, Janssen, Boehringer, Gilead, Novo Nordisk, and Fresenius, AstraZeneca
- Data safety monitoring board/clinical endpoint committee
 - AstraZeneca, Allena, Merck, and PLC
- Expert witness
 - Fresenius
- Steering Committee
 - Janssen and Zoll

Impending Shortages of Kidney Replacement Therapy for COVID-19 Patients

David S. Goldfarb ^{1,2} Judith A. Benstein,² Olga Zhdanova,^{2,3} Elizabeth Hammer,² Clay A. Block,⁴ Nina J. Caplin,^{2,3} Nathan Thompson,^{2,3} and David M. Charytan²

CJASN 15: ●●●–●●●, 2020. doi: <https://doi.org/10.2215/CJN.05180420>

Impediments to delivery of adequate KRT

- High incidence of AKI in affected patients
- Loss of hemodialysis personnel to COVID-19
- Relative inexperience of some personnel with placement of peritoneal dialysis catheters
- Relative inexperience of ICU staff and dialysis staff with performance of peritoneal dialysis
- Shortages of supplies of KRT supplies
- Resistance of overworked staff to learning new procedures or use of new equipment

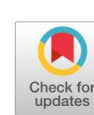
ICU Dialysis Modalities

- Intermittent hemodialysis
 - Conventional HD machine, HD nurses
- CVVH: Continuous venovenous hemofiltration
 - Slower, indicated for hemodynamically unstable people
 - Usually performed by ICU nurse
- Peritoneal dialysis
 - Recently out of favor in New York
 - Slow, continuous
 - Requires catheter placement, fluid in abdominal cavity


Peritoneal Dialysis for Acute Renal Failure: The Safe, Effective, and Low-Cost Modality

Stephen R. Ash and Susan L. Bever

Advances in Renal Replacement Therapy, Vol 2, No 2 (April), 1995: pp 160-163



Acute Kidney Injury in Critically Ill Patients: A Prospective Randomized Study of Tidal Peritoneal Dialysis Versus Continuous Renal Replacement Therapy

Abdullah Al-Hwiesh,¹ Ibrahiem Abdul-Rahman,¹  Fredric Finkelstein,² Jose Divino-Filho,³ Hatem Qutub,¹ Nadia Al-Audah,¹ Abdalla Abdelrahman,⁴ Nazeeh El-Fakhrany,¹ Mohammed Nasr El-Din,¹ Tamer El-Salamony,¹ Abdulsalam Noor,¹ Mohammed Al-Shahrani¹, and Khalid Al-Otaibi¹

¹*Nephrology Division, King Fahd Hospital of the University, Al-Khobar, Imam Abdulrahman Bin Faisal University, Saudi Arabia; and* ²*Yale University, New Haven, CT, USA; and* ³*Karolinska Institutet, CLINTEC, Division of Renal Medicine, Stockholm, Sweden; and* ⁴*Department of Electrical Engineering, Queens University, Kingston, ON, Canada*

Abstract: Few studies have discussed the role of peritoneal dialysis (PD) in managing acute kidney injury (AKI) in critically ill patients. The present study compares the outcome of AKI in intensive care unit (ICU) patients randomized to treatment with tidal PD (TPD) or continuous venovenous hemodiafiltration (CVVHDF). One hundred and twenty-five ICU patients with AKI were randomly allotted to CVVHDF, (Group A, $N = 62$) or TPD, (group B, $N = 63$). Cause and severity of renal injury were assessed at the time of initiating dialysis. The primary outcome was hospital mortality at 28 days, and secondary outcomes were time to recovery of renal function, duration of stay in the ICU, metabolic and fluid control, and improvement of sensorial and hemodynamic parameters. No statistically significant differences were observed

between groups in regard to patients' characteristics. The survival at 28 days was significantly better in the patients treated with TPD when compared to CVVHDF (69.8% vs. 46.8%, $P < 0.01$). Infectious complications were significantly less ($P < 0.01$) in the TPD group (9.5%) when compared to the CVVHDF group (17.7%). Recovery of kidney function (60.3% vs. 35.5%), median time to resolution of AKI and the median duration of ICU stay of 9 days (7–11) vs. 19 days (13–20) were all in favor of TPD ($P < 0.01$). This study suggests that there are better outcomes with TPD compared to CRRT in the treatment of critically ill patients with AKI. **Key Words:** Acute kidney injury, Acute tubular necrosis, Continuous venovenous hemodiafiltration, Renal replacement therapy, Sepsis, Tidal peritoneal dialysis.

Continuous peritoneal dialysis compared with daily hemodialysis in patients with acute kidney injury

Daniela Ponce Gabriel ¹, Jacqueline Teixeira Caramori, Luis Cuadrado Martin, Pasqual Barretti, Andre Luis Balbi

Affiliations + expand

PMID: 19270234

Abstract

Background: In some parts of the world, peritoneal dialysis is widely used for renal replacement therapy (RRT) in acute kidney injury (AKI), despite concerns about its inadequacy. It has been replaced in recent years by hemodialysis and, most recently, by continuous venovenous therapies. We performed a prospective study to determine the effect of continuous peritoneal dialysis (CPD), as compared with daily hemodialysis (dHD), on survival among patients with AKI.

Methods: A total of 120 patients with acute tubular necrosis (ATN) were assigned to receive CPD or dHD in a tertiary-care university hospital. The primary endpoint was hospital survival rate; renal function recovery and metabolic, acid-base, and fluid controls were secondary endpoints.

Results: Of the 120 patients, 60 were treated with CPD (G1) and 60 with dHD (G2). The two groups were similar at the start of RRT with respect to age (64.2 +/- 19.8 years vs 62.5 +/- 21.2 years), sex (men: 72% vs 66%), sepsis (42% vs 47%), shock (61% vs 63%), severity of AKI [Acute Tubular Necrosis Individual Severity Score (ATNISS): 0.68 +/- 0.2 vs 0.66 +/- 0.22; Acute Physiology and Chronic Health Evaluation (APACHE) II: 26.9 +/- 8.9 vs 24.1 +/- 8.2], pre-dialysis blood urea nitrogen [BUN (116.4 +/- 33.6 mg/dL vs 112.6 +/- 36.8 mg/dL)], and creatinine (5.85 +/- 1.9 mg/dL vs 5.95 +/- 1.4 mg/dL). In G1, weekly delivered Kt/V was 3.59 +/- 0.61, and in G2, it was 4.76 +/- 0.65 ($p < 0.01$). The two groups were similar in metabolic and acid-base control (after 4 sessions, BUN < 55 mg/dL: 46 +/- 18.7 mg/dL vs 52 +/- 18.2 mg/dL; pH: 7.41 vs 7.38; bicarbonate: 22.8 +/- 8.9 mEq/L vs 22.2 +/- 7.1 mEq/L). Duration of therapy was longer in G2 (5.5 days vs 7.5 days; $p = 0.02$). Despite the delivery of different dialysis methods and doses, the survival rate did not differ between the groups (58% in G1 vs 52% in G2), and recovery of renal function was similar (26% vs 26%).

Conclusion: High doses of CPD provided appropriate metabolic and pH control, with a rate of survival and recovery of renal function similar to that seen with dHD. Therefore, CPD can be considered an alternative to other forms of RRT in AKI.

HEMOFILTRATION AND PERITONEAL DIALYSIS IN INFECTION-ASSOCIATED ACUTE RENAL FAILURE IN VIETNAM

NGUYEN HOAN PHU, M.D., TRAN TINH HIEN, M.D., NGUYEN THI HOANG MAI, M.D., TRAN THI HONG CHAU, M.D., LY VAN CHUONG, M.D., PHAM PHU LOC, M.D., CHRISTOPHER WINEARLS, D.PHIL., M.B., JEREMY FARRAR, M.B., D.PHIL., NICHOLAS WHITE, M.D., D.SC., AND NICHOLAS DAY, B.M., B.CH.

Results Seventy adult patients with severe falciparum malaria (48 patients) or sepsis (22 patients) were enrolled; 34 were assigned to hemofiltration and 36 to peritoneal dialysis. The mortality rate was 47 percent (17 patients) in the group assigned to peritoneal dialysis, as compared with 15 percent (5 patients) in the group assigned to hemofiltration ($P=0.005$). The rates of resolution of acidosis and of decline in the serum creatinine concentration in the group assigned to hemofiltration were more than twice those in the group assigned to peritoneal dialysis ($P<0.005$), and renal-replacement therapy was required for a significantly shorter period. In a multivariate analysis, the odds ratio for death was 5.1 (95 percent confidence interval, 1.6 to 16) and that for a need for future dialysis was 4.7 (95 percent confidence interval, 1.3 to 17) in the group assigned to peritoneal dialysis. The cost of hemofiltration per survivor was less than half that of peritoneal dialysis, and the cost per life saved was less than one third.

Conclusions Hemofiltration is superior to peritoneal dialysis in the treatment of infection-associated acute renal failure. (N Engl J Med 2002;347:895-902.)

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Peritoneal Dialysis

Peritoneal dialysis was carried out as described previously.⁷ A rigid peritoneal-dialysis catheter was inserted with the use of local anesthesia, and an open drainage system was used. The sterile, acetate-based dialysis fluid was produced by the hospital pharmacy (dextrose, 15 g per liter or 70 g per liter; heparin, 100 IU per liter; sodium, 141 mmol per liter; chloride, 101 mmol per liter; calcium, 1.75 mmol per liter; magnesium, 0.75 mmol per liter; potassium, 1 mmol per liter; and acetate, 45 mmol per liter) and warmed to 37°C in a dedicated incubator before use. Two-liter exchanges were used with a 30-minute dwell time in the abdomen (a total of approximately 70 liters per day). In patients with fluid overload, hypertonic fluid was used, with an exchange consisting of 1 liter of a solution of 15 g of dextrose per liter and 1 liter of a solution of 70 g of dextrose per liter, producing a final dextrose concentration of 42.5 g per liter.

Peritoneal dialysis

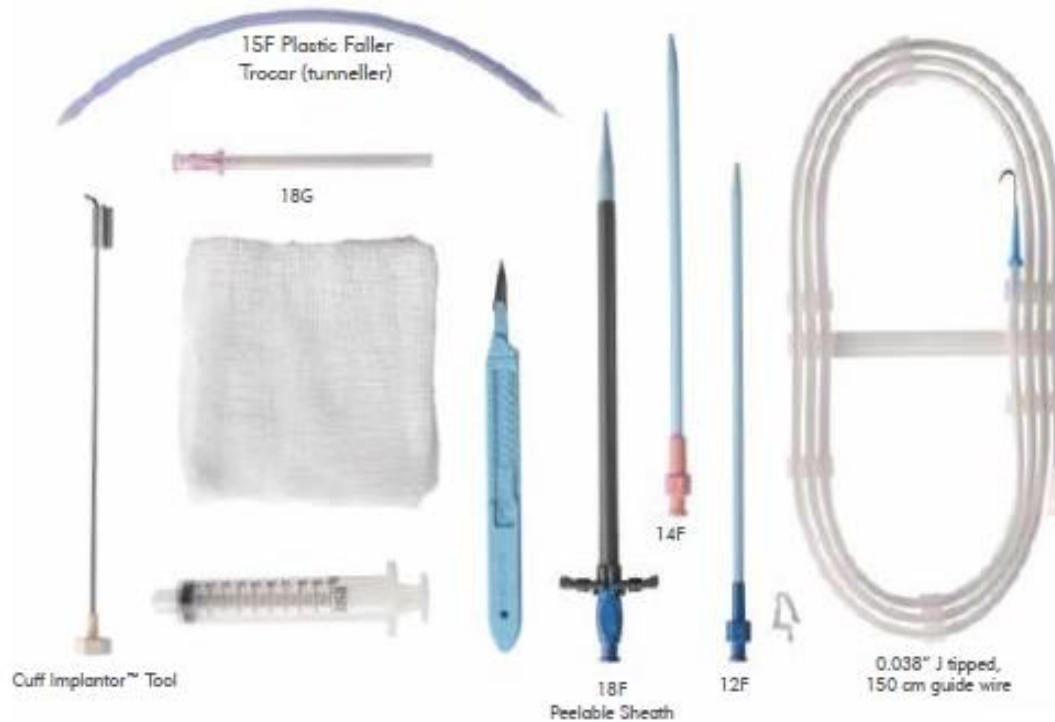


PD

Percutaneous Catheter Implantation

VP-511 PERCUTANEOUS IMPLANTATION SYSTEM

With Antegrade Catheter Faller Trocar



Suggested for Ultrasound Guided Access and Fluoroscopic Placement

VP-511 Implantation System

PD Catheter Kit

CC-2300 Titanium Catheter Connector

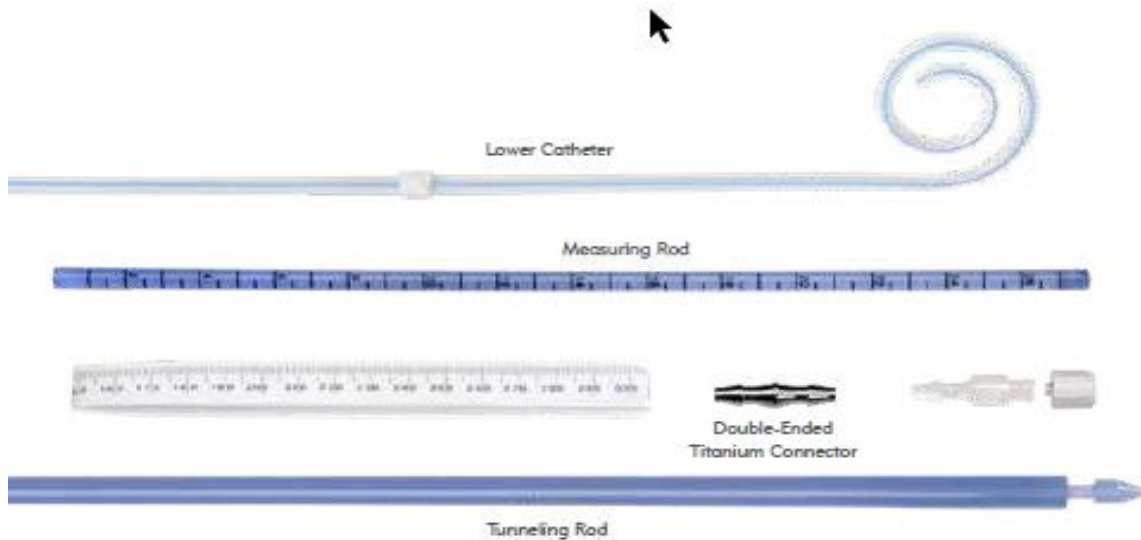
(Optional) MAK-NV™ Introducer System

(Optional) Merit Laureate® Hydrophilic Guide Wire

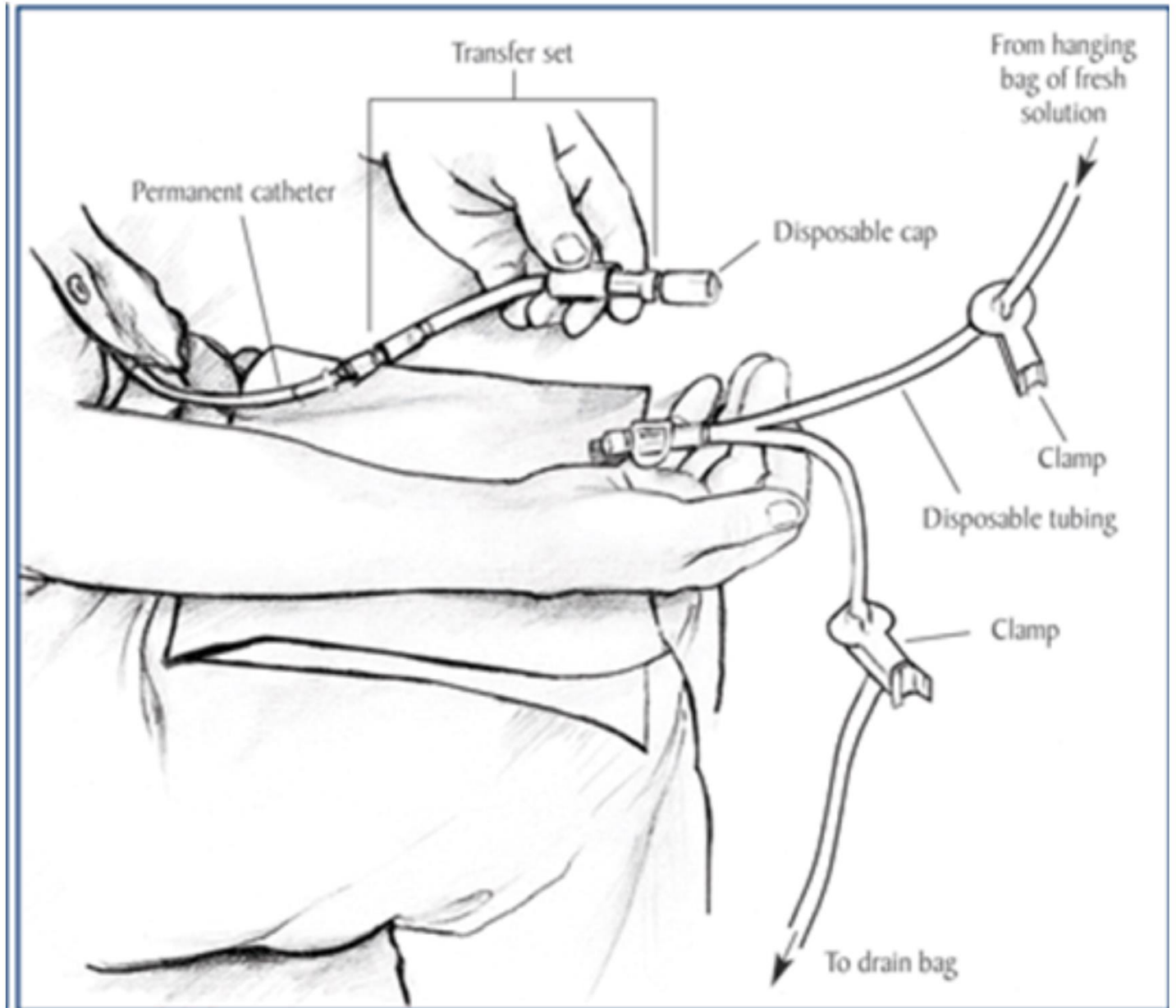
ExxTended™ Catheter Kits

CF-5560 AND CF-5570 COMPLETE EXXTENDED CATHETER KITS

Complete ExxTended™ Catheter Kit available in two configurations for upper abdomen and pre-sternal procedures. Unique site-to-site measuring tools designed for precise placement.



PD



Creating an Acute PD Program Considerations

- PD Technicians
 - Who
 - Training
- Catheter Insertion
 - Surgical vs. IR vs. Nephrology vs. Critical Care
 - Bedside vs. OR
 - Laparoscopic (? Superspreading) vs. direct visualization
- Coordination with Supply Chain-equipment needed and #s
 - Catheters
 - Cutdown trays
 - PD fluids
 - Ancillary Supplies
 - Cyclers
- Patient selection
- Catheter Insertion Protocol
- PD prescription
- ICU education

Creating an Acute PD Program Considerations

- **PD Technicians-does not need to be nursing-Bellevue program used PAs and redeployed ophthalmology and dermatology MDS**
 - Those familiar with sterile technique can learn manual PD basics in < 60 minutes
 - Continuous review and teaching once on team
 - Videos
- <https://www.pdempowers.com/hcp/hti/nurse-forum/hospital-and-skilled-nursing-facility-personnel-module-1-fundamentals-of-pd>
- <https://www.pdempowers.com/hcp/hti/nurse-forum/hospital-and-skilled-nursing-facility-personnel-module-2-clinical-interventions-for-common-complications-in-pd>
- https://urldefense.proofpoint.com/v2/url?u=http-3A_players.brightcove.net_1992769035001_default-5Fdefault_index.html-3Fvideoid-3D6032170902001&d=DwIFAg&c=j5oPpO0eBH1iio48DtsedeElZfc04rx3ExJHelIZuCs&r=Ue7cN-PZQlfHsiq6_gBp8xGgSlPqKXiy_AY8eJLmMH4&m=ljTKvGk0jfMJETAHrkYf5lcdA1EVeoyQsQtn4vTNsLM&s=fsSIZO0NRlv6e3leGGHTKYicxo74ExOXC0X6a99bAyg&e
- https://www.youtube.com/watch?v=-FDbo_e2oAM
- **Catheter Insertion-need a clear line of command/good communication**
 - Daily review of lists and contact with proceduralist
- **Coordination with Supply Chain**
 - Detailed lists of all supplies and expected needs
 - Catheters and transfer sets needs to be readily available to teams (think HD catheter)

Catheter Insertion

- Laxative
- Peri-operative anti-biotic
- Direct visualization with minimal dissection
- Flexible, double-cuffed catheters
 - Lateral placement to help with proning
 - The cuff is secured to the posterior fascia with a stitch
 - The anterior fascia is closed with 2-0 vicryl suture

PD Contraindications

- Known varices
- Prior lower abdominal surgery (relative contraindication)
- Known abdominal adhesions
- Hyperkalemia >6.5 mEq/L refractory to medical management or with evidence of cardiac instability/arrhythmia

PD Candidates

- AKI patients
- Stage 5 progressing to ESRD
- AKI patients who have initiated HD or CVVH without contraindication for PD and expected to have a prolonged hospital stay (unloading the HD/CRRT service)
- Last choice--admitted ESKD patients on HD

PD Rx

- Initial protocol
 - Flush with 500 cc x3
 - 500 cc x 2 hours—2.5%
 - Increase by 250 cc/fill every 2-3 exchanges for first 6 then by 500/exchange
 - Target 2L/exchange within 48-72 hours
 - Heparin in initial exchanges
 - Dwell time 2 hours with 5-8 exchange/day
 - Reduce volume or hold 12 hours for leaks
 - Gent to exit site
 - Adjust prn needs
- Transfer to cyclers when available—17-20L exchange volume

Keys to Success

- Multi-disciplinnary engagement in program development
- Clear education plan, stepwise progression from manual to cyclers
- Daily review of eligible patients with direct communication between proceduralist and nephrologist
- Nephrologist led daily PD rounds with PD “nursing” team, ICU team and nephrology staff

Manual PD vs. Cyclers





A 12-foot cyclor standard drain line extension (life hack) can extend from usual PD catheter transfer set by 12 feet (Baxter only). A second transfer set is attached at the end of the extension. Multiple extenders can fit together so it can be even 24 ft.

Peritoneal dialysis at Bellevue

Outcome	Male	Female	Total
Patient who received PD catheters	29	10	39
Recovered prior to starting PD	1	0	1
ESKD	1	1	2
Recovered and had catheter removed*	9/27 (33%)	5/9 (56%)	14/36(39%)
Expired on PD	20/28 (71%)	4/10 (40%)	24/38 (63%)
Average age of all patients (years)	59.5	66.2	59.5
Average age, recovered patients	56	59.5	57.6
Average age, expired patients	71.8	62.3	60.6

- Peritonitis: 0
- Non-functioning catheter, converted to HD: 1
- Catheters requiring revision-2
- Successfully dialyzed: 35
 - (2 improved before treatment initiated)
- Received PD while in prone position: 7
- BMI<30: 13; BMI 30-40: 18; BMI > 40: 4
- Leaks-9, all transient and managed conservatively—none required stopping PD

Challenges

- **Despite success-bias remains against PD as an inferior, 2nd choice therapy**
- **Surgical team less available now that elective procedures have resumed**
- **Nursing redeployed**

COVID-19: critical illness and AKI

First ~ 200+ symptomatic COVID 19 positive patients
admitted to Elmhurst Hospital Center March - April.

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Coronavirus disease 2019 (COVID-19)

- ▶ From mid-March through early May, 2020, New York City was the epicenter of the United States outbreak.
 - ▶ For NYS, > 400,000 confirmed cases, with > 32,000 deaths
 - ▶ *2/3 from in NYC*
 - ▶ Elmhurst Hospital Center is a public, 450 bed hospital in Queens, which cares for a large immigrant population primarily from central and south America but from Asia as well
- ▶ In these first weeks, we and physicians from other NY centers, witnessed an inordinate amount of respiratory failure and ARDS; often accompanied by an impressive development of AKI
 - ▶ older adults with comorbidities such as diabetes mellitus and cardiovascular disease were at highest risk of hospitalization, ICU admission, and death

Early AKI Demographics:

first 200+ COVID (+) patients admitted

	AKI (98)	Non-AKI (118)	p-value
Age	60.62	57.55	0.18
BMI	29.4	20.07	0.78
Male (%)	81.96	80.89	0.86
Female (%)	18.03	19.1	
HTN	65	58	0.011
Diabetes	45	47	0.37
Hispanic (%)	57.37	65.16	0.33
Asian (%)	29.5	17.97	0.09
Black (%)	4.91	5.61	0.85
White (%)	8.19	11.23	0.05
Undocumented	22	14	0.018
Ventilator assistance	76	22	<0.001

	AKI (n=98)	Non-AKI (n=118)	p-value
Na	136	136	0.72
K	4.4	4.4	0.56
Bicarb	20	22	0.0004
Ca	8.1	8.3	0.011
Phosphate	3.4	3.6	0.73
BUN	23	15	0.0003
Creatinine	1.17	.96	0.009
Albumin	3.6	3.8	0.0001
Ferritin	1052.5	986	0.593
Hemoglobin	13.28	13.23	0.89
WBC	10.4	9.16	0.09
CPK	256	172	0.08
Urine WBC	16.58	12.47	0.25

Admission Labs: AKI vs non-AKI

AKI higher:

- BUN
- Creatinine
- Higher ratio

AKI lower:

- Bicarb
- Ca⁺⁺
- albumin

*

	Variable	No AKI	AKI	P-value
<u>Admission</u> Biomarkers				
-of Inflammation	Procalcitonin	.265	.445	0.005
	IL-6	79.2	117	0.0112
	CRP	133	218	0.0002
-of coagulopathy	LDH	480.5	623	0.0001
	D-Dimer	384	475	0.038

	Variable	No AKI	AKI	P-value
<u>Maximum</u> Biomarkers				
-of Inflammation	Procalcitonin	.43	2.39	0.0001
	IL-6	119.8	235.6	0.0065
	CRP	196.6	300	0.0001
-of coagulopathy	LDH	526.5	711	0.0001
	D-Dimer	879	5855.5	0.0001

Early AKI vs non-AKI

- ▶ Almost all patients had some urinary WBCs;
- ▶ Bicarb and albumin levels were lower on admission; BUN and creatinine higher
- ▶ LDH, procalcitonin, d dimers and CRP were higher in AKI; which continued to increase
- ▶ 76% required ventilator assistance

Management

▶ Potassium control

- ▶ control of Acidemia -earlier bicarbonate use during permissive hypercapnia
- ▶ Feed -permits insulin production
- ▶ Binders - zirconium

▶ Renal replacement therapy (RRT)

- ▶ Intermittent hemodialysis
- ▶ SLEDD
 - ▶ Personnel
 - ▶ Dialysate
 - ▶ Lower DFRs used
- ▶ Combination with multiple days

COVID AKI at Elmhurst: acute renal replacement therapy (RRT)

▶ First week of April

- ▶ Ordinarily the hospital has 10 - 12 patients per week receiving for 30 - 40 RRTs.
- ▶ 118 patients were placed on hemodialysis or sustained low efficiency daily dialysis (SLEDD)
 - ▶ represents ~ 30-40 admitted patients
 - ▶ 17 patients/day had RRT

COVID AKI at Elmhurst: acute renal replacement therapy (RRT)

▶ Month of April

- ▶ The peak week had over 50 patients requiring RRT
- ▶ An average 24 patients/day were placed on hemodialysis or sustained low efficiency daily dialysis (SLEDD)
- ▶ on average ~1/3 were ESRD or 5 ESRD patients per day
- ▶ ~46% of AKI patients were placed on SLEDD or low flow dialysis

Outcomes: first 200+ COVID (+) patients admitted

	AKI (98)	Non-AKI (118)	p-value
Days to Death	9.94	8.57	0.16
Mortality (%)	73	21	<0.0001
Ventilated (%)	76	22	0.001

	Incidence	Mortality
Overall		44%
Patients ventilated	47.6%	75%
Patients with AKI	43.5%	73%

AKI
 -Higher need for ventilation

 -higher mortality

 76% of the ventilated patients developed AKI

Admitted ESRD patients

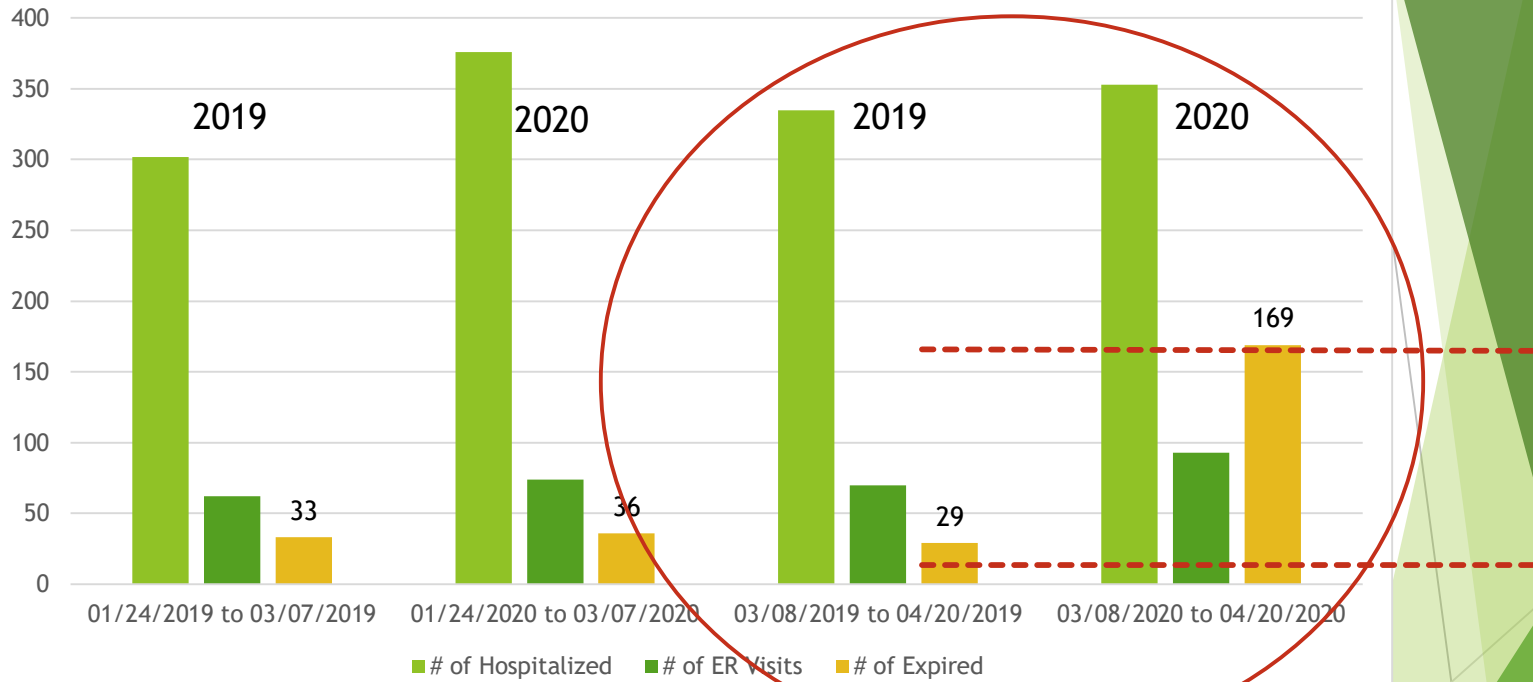
- ▶ on average ~1/3 were ESRD or 5 ESRD patients per day

- Risk factors for hospitalization and death of a COVID-19(+/S) cohort. The non-adjusted odds ratio (OR) and the 95% confidence interval (CI95) is indicated for each outcome

- 2,178 dialysis patients were screened 1st month:
- 306 were COVID-19(+/S) and ~80% (n=244) confirmed positive COVID-19
 - Common signs/ symptoms of COVID-19; fever (44%), cough (28%), weakness/fatigue (20%)
 - an incidence of 111 per 1,000 dialysis patients (overall population NYC rate of 25 per 1,000)
- Hospitalizations: 178 (58%), 8% of total SDO
 - Patients residing in Queens had significantly increased odds of hospitalization (OR 2.4, 95%CI 1.0-5.7).
 - likely reflects the high Queens population density
- Deaths 85 (28%) in the COVID-19(+/S) cohort; 4% of the total SDO
 - The expired were older (70, SD: 11.9), had a higher ESKD vintage at 5.5 (SD: 4.4) years and a higher male %.
- Hospitalized deaths (26.8%) vs not hospitalized (28.9%), not significantly different
 - demonstrating a significant at-home mortality.

	Hospitalization		Death	
	OR(CI95)	P-value	OR(CI95)	P-value
Borough/City				
Manhattan	1		1	
Queens	2.4 (1.0-5.7)	0.05	1.6 (0.6-4.9)	0.4
Brooklyn	1.8 (0.7-4.4)	0.3	2 (0.7-6.1)	0.2
Bronx	1.8 (0.6-5.2)	0.2	2.3 (0.7-8.2)	0.2
Long Island	1.6 (0.5-5.2)	0.4	1.8 (0.5-7.0)	0.4
Gender				
Female	1		1	
Male	0.7 (0.4-1.2)	0.2	1.3 (0.8-2.2)	0.3
Race/ethnicity				
White	1		1	
Black	0.5 (0.2-1.1)	0.1	1.1 (0.4-2.6)	0.9
Hispanic	0.5 (0.2-1.2)	0.1	1.0 (0.4-2.3)	0.9
Asian	0.4 (0.1-1.0)	0.06	1.4 (0.5-3.9)	0.5
Multiracial or other	0.4 (0.03-4.0)	0.4	2.8 (0.2-30.3)	0.4
SSN				
No	1		1	
Yes	1 (0.6-1.8)	0.9	0.4	0.004*
Age				
18-44	1		1	
45-54	1.2 (0.4-3.0)	0.7	0.9 (0.2-3.8)	0.9
55-64	0.8 (0.3-1.8)	0.5	2.4 (0.7-8.4)	0.2
65-74	0.8 (0.3-1.7)	0.5	3.4 (1.0-11.3)	0.05
75 or older	1.2 (0.5-3.0)	0.6	7.4 (2.2-24.8)	0.001*
ESKD Vintage	1 (0.9-1.0)	0.3	1.1 (1.01-1.14)	0.01*
Diabetes				
No	1		1	
Yes	1.3 (0.8-2.0)	0.3	1.2 (0.8-2.1)	0.4
Hypertension				
No	1		1	
Yes	0.9 (0.6-1.4)	0.7	0.8 (0.5-1.3)	0.3
CHF				
No	1		1	
Yes	0.8 (0.4-1.4)	0.4	1.8 (0.9-3.4)	0.1
CAD				
No	1		1	
Yes	0.7 (0.4-1.3)	0.3	1.3 (0.7-2.5)	0.5

Comparison of Hospital/ ED Visits and Mortality Counts to Periods Before Pandemic COVID-19



There are 55 un-accounted deaths

The background features abstract, overlapping green geometric shapes in various shades, primarily on the right side of the page. The shapes include triangles and polygons, creating a modern, layered effect. The colors range from light lime green to dark forest green.

Thank you

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COVID-19: Acute Kidney injury Response

Jeffrey Silberzweig, MD



Member
NewYork-Presbyterian
Regional Hospital Network

GNYHA Webinar July 21, 2022

Patient Volume

- Between March 26 and April 24, hospital systems in New York City double ICU bed capacity.
- At baseline, 5-10% of patients in ICUs require dialysis by multiple reports.
- Acute kidney injury complicates at least half of cases of COVID-19 requiring ICU care.
- Estimates indicate that 25-90% of patients in ICUs are receiving renal replacement therapy: most receive continuous dialysis therapies.
- The volume of patient receiving continuous dialysis increased approximately 5X over this time period.

Continuous Dialysis Therapies

- Due to the expanded need for treatments, concerns arose that there would be inadequate supply of machines, fluids and trained staff to provide continuous therapies.
- To ensure that all patients received sufficient therapy to provide metabolic and volume control, physicians found innovative solutions:
 - Reduced Dialysate Flow Rates
 - Standard CRRT uses 50 mL/min (72 L/day)
 - Reduced flow CRRT can be done at 15 mL/min (21.6 L/day)
 - Prolonged Intermittent Renal Replacement Therapy (PIRRT)
 - Depending on individual metabolic needs, patients are treated for 8-12 hours daily.
 - Machines can be used to treat 2-3 patients each day.

Addressing Fluid Shortages

- After about three weeks of this level of increased capacity, many hospital systems in New York became concerned that they would not have sufficient fluid to treat patients in the coming days.
- The American Society of Nephrology's COVID-19 Response team convened a meeting with the clinical leadership of Northwell, NYC HHC, NYU, New York-Presbyterian, Mount Sinai, Albert Einstein and New York Medical College.
- Information was distributed to:
 - Manufacturers (Baxter and NxStage/Fresenius)
 - The Federal Government (ASPR, CMS and FDA)
 - Via the Greater New York Hospital Association to Governor Cuomo
- Additional fluids, machines and staff were brought to avert crisis

AKI in COVID-19

Westchester Medical Center Experience

July 21, 2020



AKI in COVID-19 Westchester Medical Center Experience

- Between early March and early June approximately 246 patients with confirmed (tested positive) COVID-19 were diagnosed with AKI at Westchester Medical Center. “Mild /moderate” (KDIGO 1/2) AKI cases may not have been recorded
- Of these (PRELIMINARY coded data through June 2020
- 80 patients (32 % of patients with AKI) required dialysis support . The vast majority received CRRT
 - Survival rate among COVID 19 positive ICU patients with AKI was 52% (discharged).
 - Survival among COVID-19 who required dialysis 25%
 - Survival among COVID-19 AKI patients who did not receive or require HD 65%

AKI in COVID-19

Westchester Medical Center Experience

- Approximately 50-55 patients at any point in time required simultaneous RRT.
 - ICU population LOS was about 95 -105 most days.
- About 20 patients were typically maintained on CVVHD-choice largely based on hemodynamic instability and staffing availability (CRRT initiated by hemodialysis staff; maintained by ICU). Average age 60.6; 82% male.
- Under normal circumstances typical dialysate use is approximately 50 to 70 L/day/pt
- Dialysis prescription changed to mix of CVVHDF and CVVHD due to fluid shortages.
 - Prescription changed to 1-1.5 L/h of dialysate and 500 cc/h of convective clearance using Plasma-Lyte, NS, or Lactated Ringers depending on patient's pH and fluid availability.
 - If potassium under 4.5 Ringer's Lactate used; if potassium over 4.5 bicarb or saline used depending upon the pH.
 - Typically if pH under 7.30-7.35 used bicarbonate based (D₅W or 0.45NS and bicarb) with bicarbonate adjusted based on pH.
 - Total CVVHD Clearance typically maintained at 20-25 ml/kg/hr.

AKI in COVID-19

Westchester Medical Center Experience

- Hyperkalemia routinely present, related to marked shortage of K2 dialysate and catabolic state-majority of patients received binders including sodium zirconium, and occasionally kayexalate; bicarbonate drip, insulin and D50 routinely utilized.
- System clotting was a major issue most patients were maintained on full dose heparin anticoagulation. Argatroban used if HIT suspected.
- Remaining patients maintained on routine hemodialysis - times typically 2-1/2-3 hours due to patient volume and staff availability. Typically performed HD close to 24 hours/day
- Fluid clearance took precedence over solute clearance-typical BUNs about 30-50 points higher than routine HD patients.

Questions?



Spread the Science, NOT the Virus

Clinical Lessons from the Northeast Surge Series

Next Week: Obstetrics and Birthing During COVID-19

7/28/20 4:00 pm ET | [Register Here](#)

Featuring:

Katherine Campbell, MD, MPH, Yale New Haven Hospital

Dena Goffman, MD, New York Presbyterian Hospital and Columbia University Medical Center

Christian Pettker, MD, Yale New Haven Hospital

Blair Wylie, MD, MPH, Beth Israel Deaconess Medical Center

Weekly Webinar recordings can be found at Jefferson Digital Commons:

<https://jdc.jefferson.edu/covid-19-ssnv>

For more information or questions visit [our website](#)
or contact Mary.R.Cooper@Jefferson.edu.

Thank You!