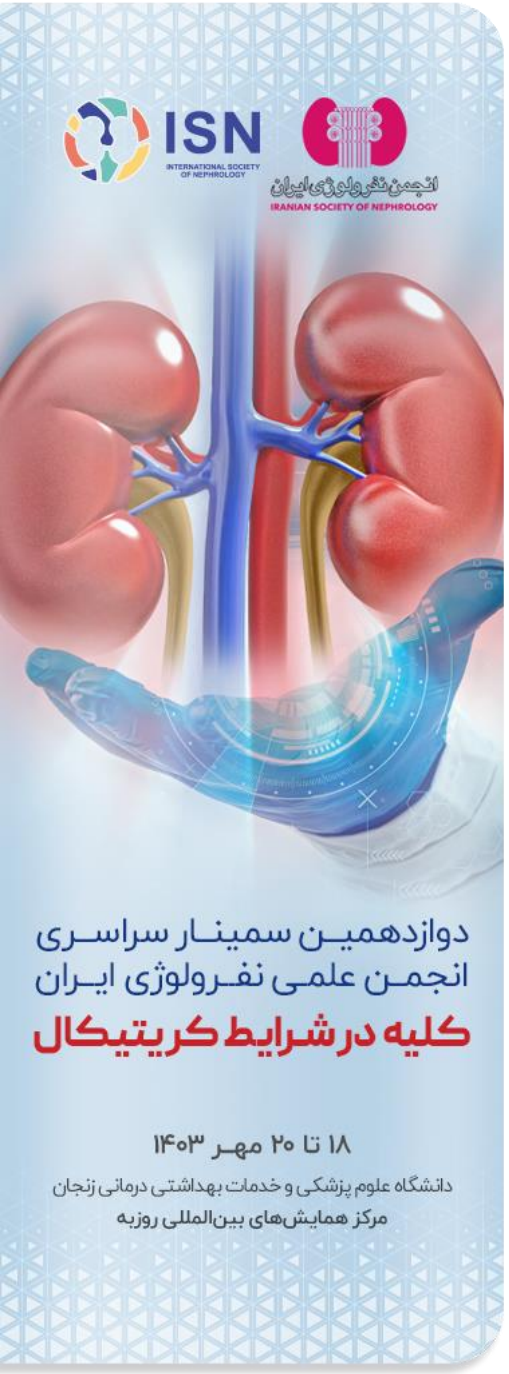
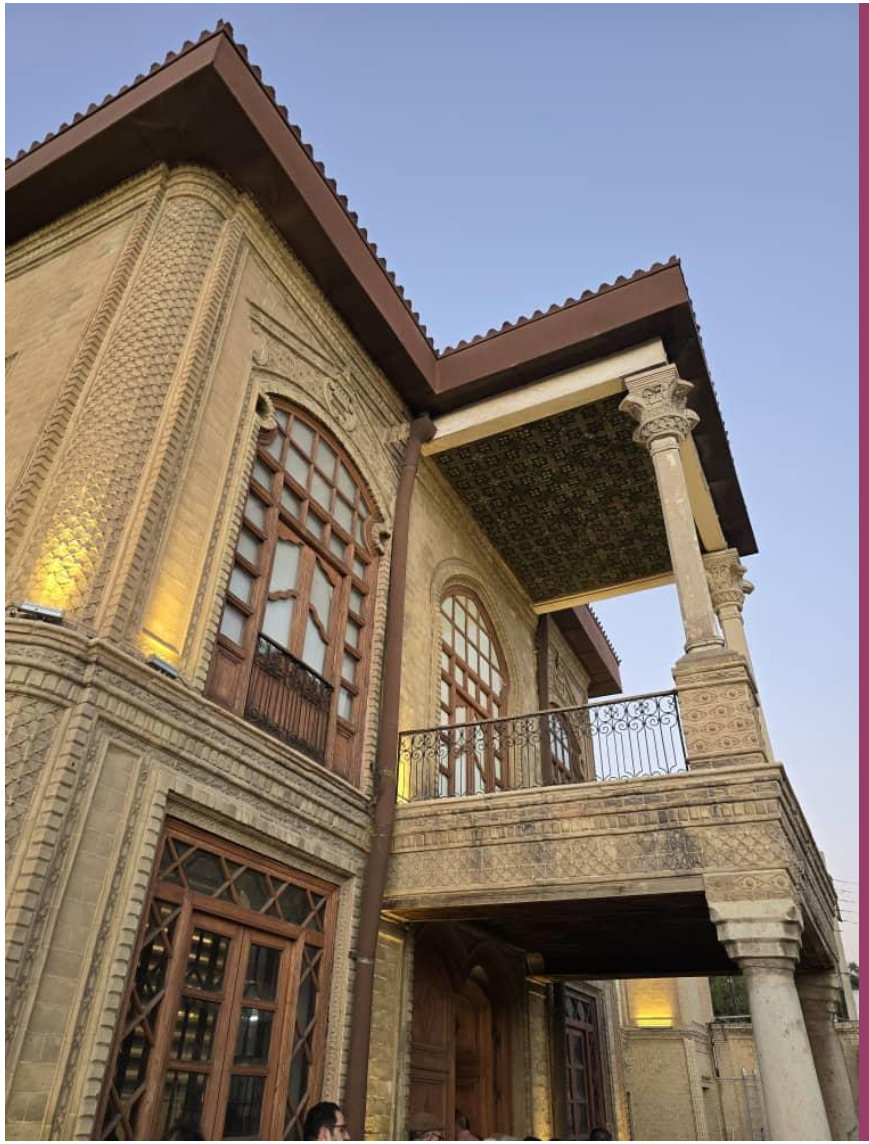


Prolonged Intermittent Kidney Replacement Therapy (PIKRT)

Abbas Etminan

Nephrologist



Thank you
Event Organisers

PIKRT (PIRRT) or:

Sustained low-efficiency (daily) dialysis (SLED or SLEDD)

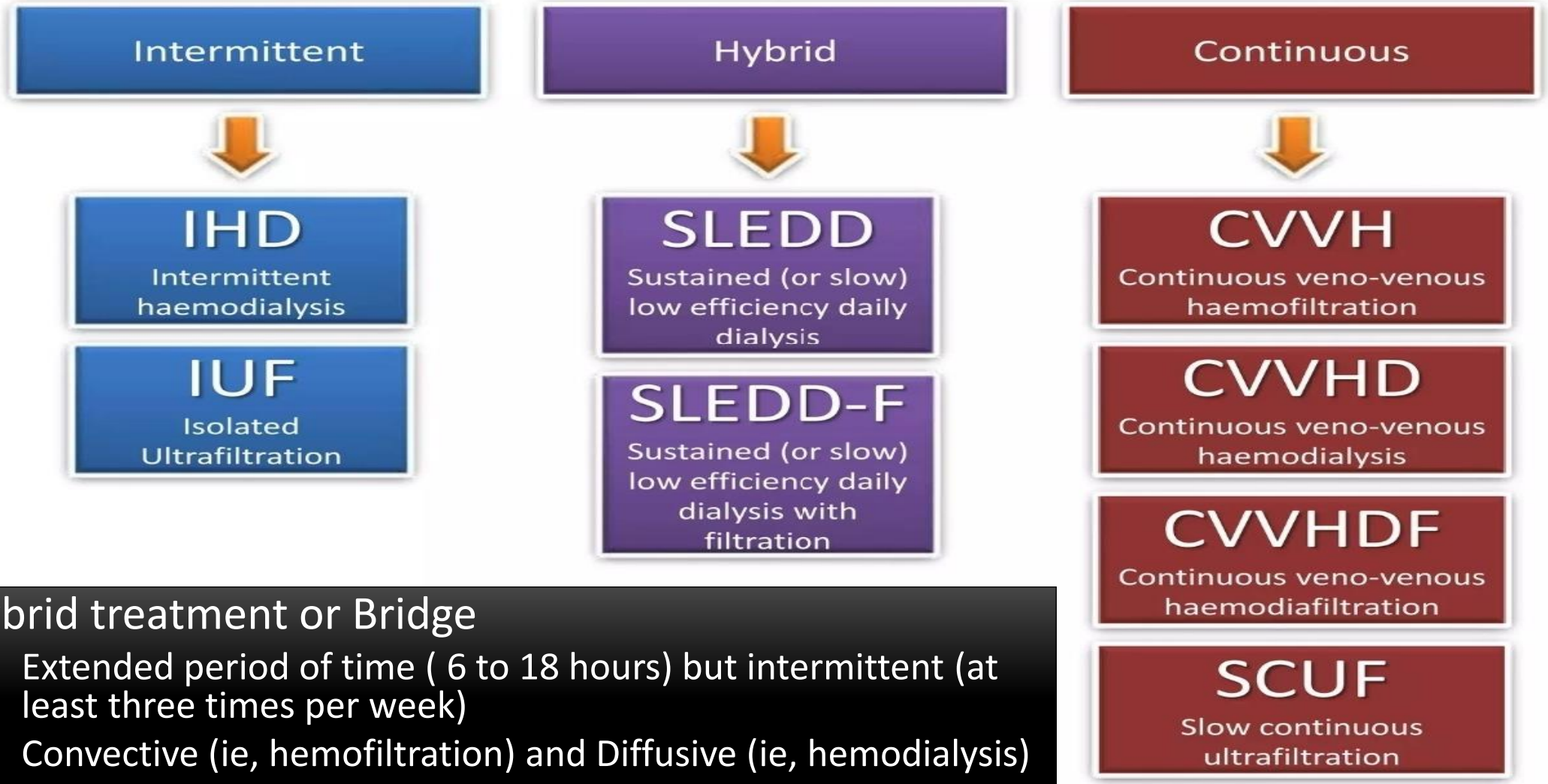
Sustained low-efficiency (daily) diafiltration (SLEDD-f)

Extended daily dialysis (EDD)

Slow continuous dialysis (SCD)

Accelerated venovenous hemofiltration (AVVH) or hemodiafiltration (AVVHDF)

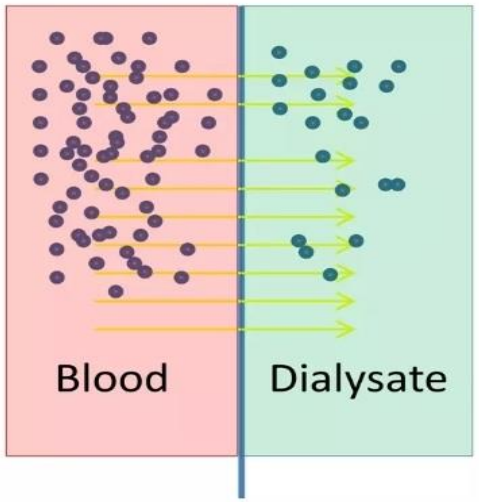
Major Renal Replacement Techniques



- Hybrid treatment or Bridge
  - Extended period of time (6 to 18 hours) but intermittent (at least three times per week)
  - Convective (ie, hemofiltration) and Diffusive (ie, hemodialysis)

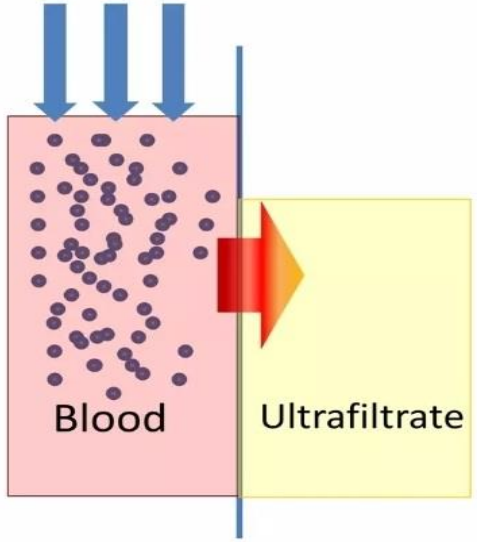
Principles of RRT

Diffusion

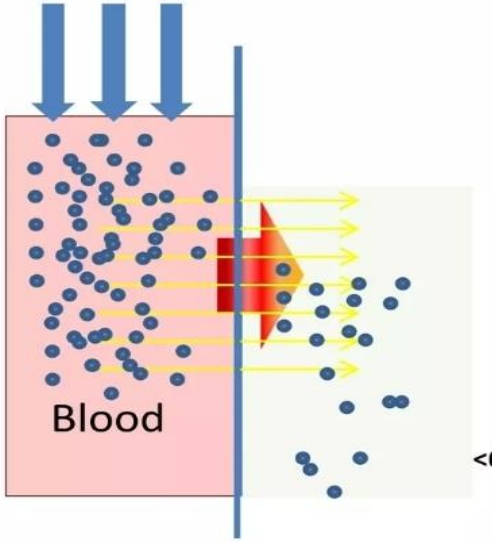


<20 kDa

Ultrafiltration



Convection



<60 kDa

The **ultrafiltration rate** is determined by

- transmembrane pressure,
- water permeability,
- pore size,
- surface area, and
- membrane thickness.

HYBRIDS or PIRRT

CRRT
High intensity
Low efficiency

IHD
Low Intensity
High efficiency

SLED, SLED-f
Higher Intensity
Lower efficiency

Trying to be more like CRRT

Trying to be more liken iHD

Lower intensity
Higher efficiency

AVVH
SHIFT CVVHD

Hemodynamic stability
Steady state

Machine hours dependent
Expensive

Fast removal
Free Machine hours

No steady state
No Hemodynamic Stability

Early Development

- 1980s-1990s: The concept of extending intermittent hemodialysis sessions (Researchers like Schlaper)
- 2000s: Terms such as Extended Dialysis (ED), Extended Daily Dialysis (EDD), Slow Low Efficiency Daily Dialysis (SLEDD), and Sustained Low Efficiency Dialysis (SLED) were coined

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ORIGINAL INVESTIGATION · Volume 36, Issue 2, P294-300, August 2000

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Extended daily dialysis: A new approach to renal replacement for acute renal failure in the intensive care unit

Victoria A. Kumar, MD · Maureen Craig, RN, MSN · Thomas A. Depner, MD · Jane Y. Yeun, MD

Affiliations & Notes Article Info

1- One nurse to manage more than one treatment
2- Well tolerated
3- Same benefits provided by CVVH
4- Technically easier to perform

Clinical Trial > Int J Artif Organs. 2004 May;27(5):371-9. doi: 10.1177/039139880402700505.

Extended daily dialysis vs. continuous hemodialysis for ICU patients with acute renal failure: a two-year single center report

V A Kumar [1], J Y Yeun, T A Depner, B R Don

Affiliations + expand

PMID: 15202814 DOI: 10.1177/039139880402700505

We conclude that EDD is a safe, effective alternative to CRRT that offers comparable hemodynamic stability and excellent small solute control.

COVID 19 Pandemic: Shortage of Time and Resources

Article | PDF Available | Literature Review

Kidney Complications of COVID-19: A Systematic Review and Meta-Analysis

February 2021 · Journal of Research in Health Sciences 21(1)

DOI:10.34172/jrhs.2021.39

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Kerman University of Medical Sciences

Conclusions: The AKI is a considerable complication among COVID-19 patients and should be screened for on clinical examinations. The BUN, SCr, potassium, and sodium levels were within the normal ranges.

Management of Acute Kidney Injury in Coronavirus Disease 2019

Sana Shaikh, Gonzalo Matzumura Umemoto, and Anitha Vijayan

CLINICAL SUMMARY

- COVID-19 is associated with a high incidence of AKI.
- Timing, modality, and dose of KRT for patients with COVID-19 associated AKI is similar to other critically ill patients with AKI.
- Hypercoagulability poses a significant problem in patients with COVID-19 and appropriate anticoagulation should be considered for all patients undergoing KRT.
- Providing KRT in the midst of a pandemic poses significant challenges and a coordinated effort is required to manage resources, and to provide treatments in a timely manner to all patients who are deemed appropriate candidates for KRT.

ACKD

Management of Acute Kidney Injury in Coronavirus Disease 2019

Sana Shaikh, Gonzalo Matzumura Umemoto, and Anitha Vijayan

Table 1. Practice Changes in Delivery of Kidney Replacement Therapy During COVID-19 Pandemic

Standard Practice	Potential Practice Change in Setting of Surge	Potential Complications with Practice Change
CKRT dosing: effluent flow rate of 20-25 mL/kg/h	In patients who have achieved metabolic control, effluent dosing can be decreased to 15 mL/kg/h to conserve dialysate and replacement fluid	Worsening metabolic control with acidosis and hyperkalemia. Inadequate clearance of medications
CKRT machine set-up: By the bedside in the patient's room	Extension tubing to keep machine outside the room to decrease exposure to healthcare personnel and reduce use of PPE	Hypothermia due to inadequate warming of blood in the return line Disconnections of tubings leading to exsanguination
CKRT solutions: Sterile bicarbonate-based dialysate	Substitute lactate solutions due to shortage of bicarbonate solutions	Lactate solutions may worsen hemodynamic instability. Not suitable in patients with severe shock,
		manifestations and volume overload
Peritoneal Dialysis: not usually used in the US in management of adult patients with AKI	Acute PD can be used in case of KRT fluid, machine and filter shortage	Personnel not familiar with placement of PD catheter PD is not suitable for patients who are proned or with high mechanical ventilator needs. Volume regulation is not feasible with PD

CKRT, continuous kidney replacement therapy; CVVHD, continuous venovenous hemodialysis; CVVHDF, continuous venovenous hemodiafiltration; IHD, intermittent hemodialysis; PD, peritoneal dialysis; PIKRT, prolonged intermittent kidney replacement therapy; PPE, personal protective equipment; SLED, sustained low-efficiency dialysis; spKt/Vurea, single-pool Kt/Vurea.

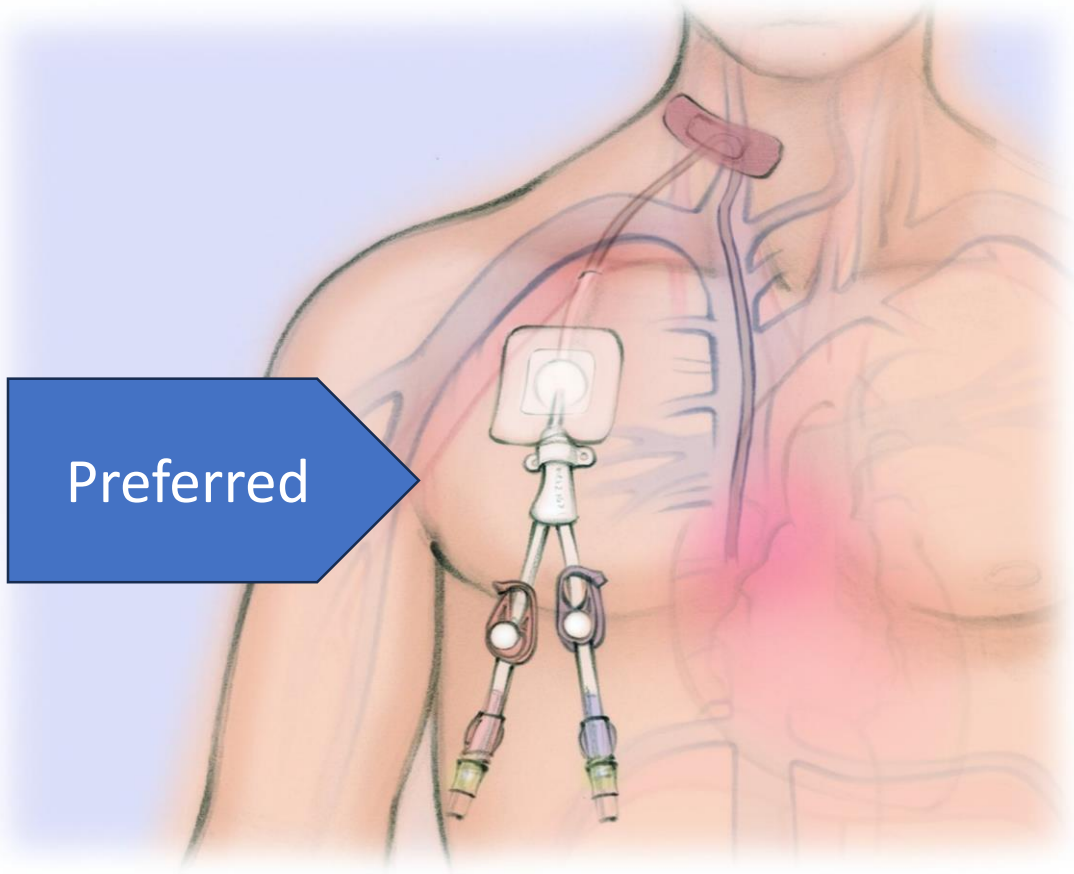
PIKRT: used as a substitute for either CKRT or IHD in some institutions

PIKRT was implemented in some institutions to allow on CKRT machine to be used for 2-3 patients

Indications

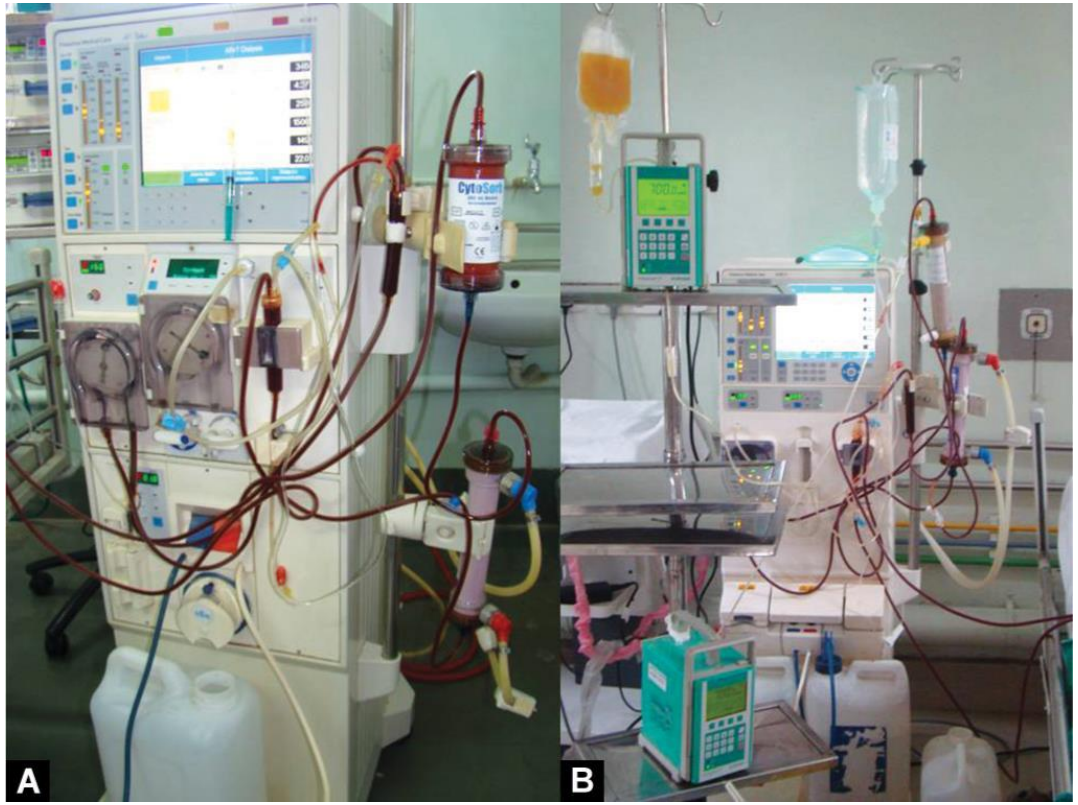
- Hemodynamically unstable patients
- Staff shortages
- Additional time for other procedures

VASCULAR ACCESS



Dialysis machines

- Machines used for PIKRT should have the capability to run at **low blood and dialysate flow rates**



Dialysate flow rate

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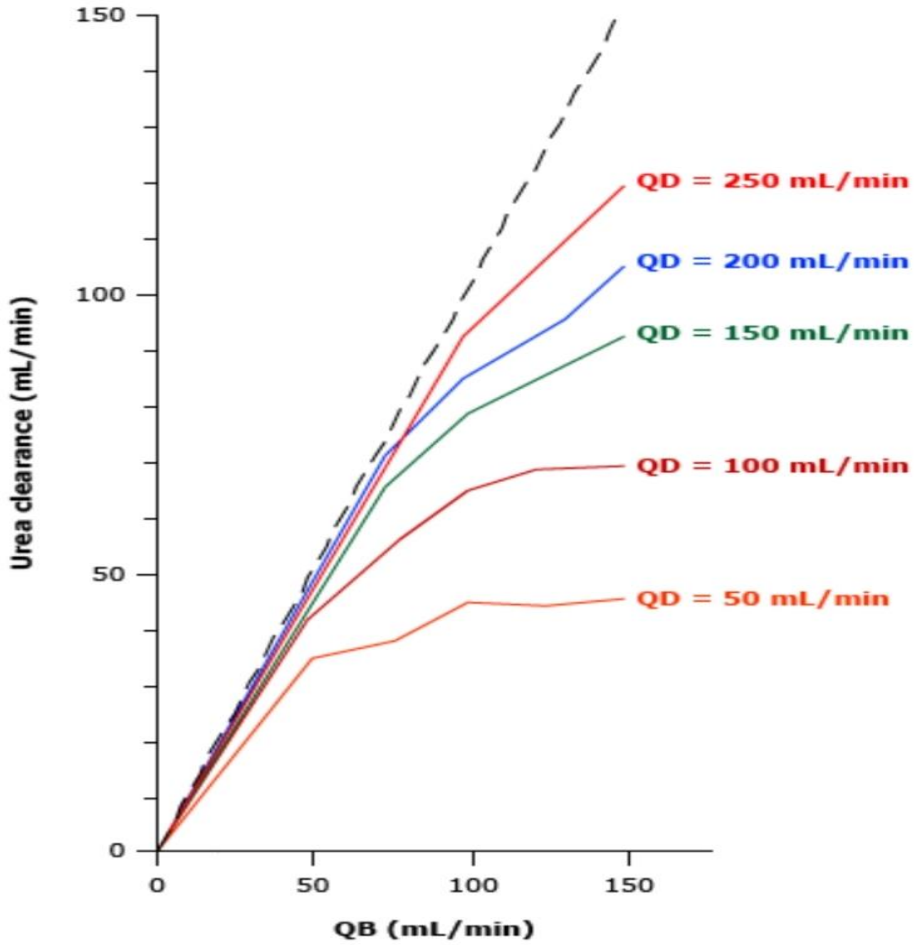
- Dialysate flow rate of 300 mL/min for individuals with severe acidosis or hyperkalemia
- Decreasing the dialysate flow rate to 100 or 200 mL/min if the anticipated session length is increased to ≥8 hours, continuing to use a dialysate flow rate of 300 mL/min if the session is expected to be <8 hours

Graph showing determinants of urea clearance during sustained low efficiency dialysis

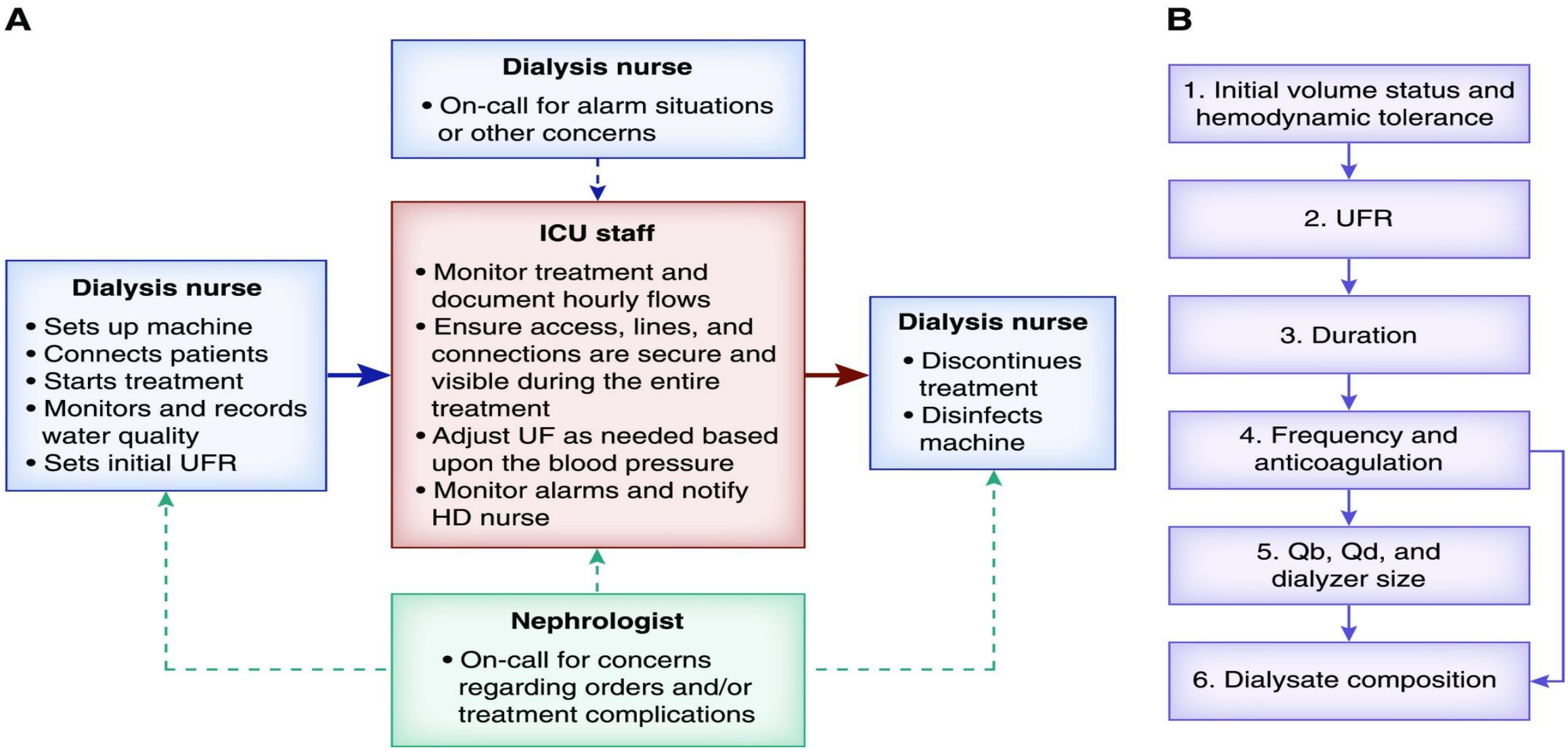


Relationship among urea clearance, blood flow rate (QB), and dialysate flow rate (QD) during sustained low efficiency dialysis (SLED). The flattening of the urea clearance curves describe the conditions in which increases in QB do not enhance clearance.

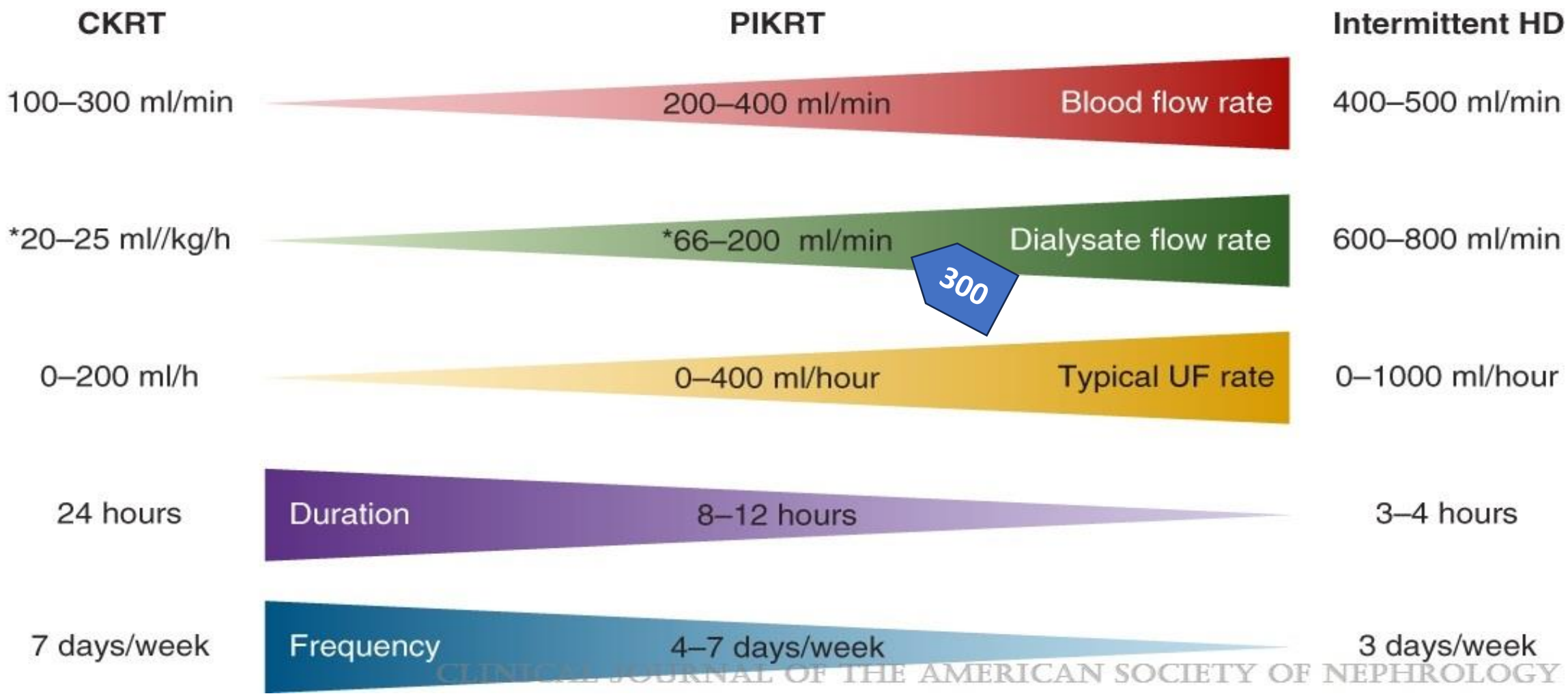
QD: dialysate flow rate; QB: blood flow rate.

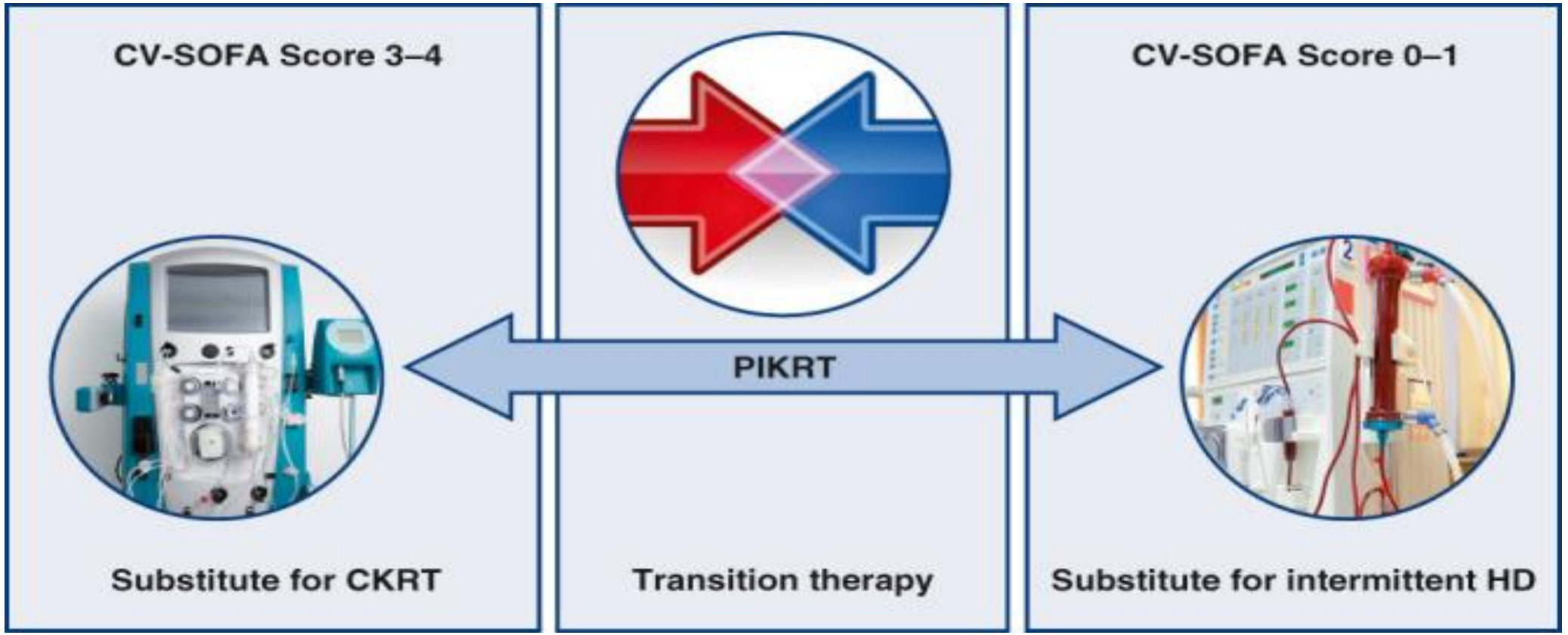
Data from: Kudoh Y, Imura O. Slow continuous hemodialysis—new therapy for acute renal failure in critically ill patients—Part 1. Theoretical consideration and new technique. Jpn Circ J 1988; 52:1171.

Walkaway prolonged intermittent kidney replacement therapy (PIKRT) implementation and prescription



PIKRT Prescription





- **Use of PIKRT in the ICU.** PIKRT can be used as a substitute for CKRT or intermittent HD, or as a transition between CKRT and intermittent HD during de-escalation of care in the ICU. The Cardiovascular Sequential Organ Failure Assessment (CV-SOFA) score is one of the many tools used to determine hemodynamic stability of the patient. CV-intermittent HD SOFA SCORE: mean arterial pressure (MAP) >70=0, MAP <70 mm Hg =1, dopamine ≤5 or dobutamine (any dose) =2, dopamine >5, epinephrine ≤0.1, or norepinephrine ≤0.1=3, dopamine >15, epinephrine >0.1, or norepinephrine >0.1=4.

Efficacy and Hemodynamic Outcome of Prolonged Intermittent Renal Replacement Therapy (PIRRT) in Critically Ill Patients: A Preliminary Report

Ranistha Ratanarat MD*,
Thunyarat Chaipruckmalakarn MD*, Nopparat Laowahutanont MD*,
Nuttasith Larpparisuth MD*, Somkiat Vasuvattakul MD*

** Department of Medicine, Faculty of Medicine, Siriraj Hospital, Mahidol University, Bangkok, Thailand*

ประสิทธิภาพและผลลัพธ์ทางพลศาสตร์การไหลเวียนเลือดของการฟอกเลือดชนิดไม่ต่อเนื่องนาน 8 ชั่วโมงในผู้ป่วยวิกฤต

รณิษฐา รัตนะรัต, ธัญญรัตน์ ชัยพฤกษ์มาลาการ, นพรัตน์ เลาวหุตานนท์, นัฐสิทธิ์ ลาภปริสุทธิ, สมเกียรติ วสุวัฏฏกุล

ภูมิหลัง: *ภาวะไตวายเฉียบพลันเป็นภาวะที่พบบ่อยในผู้ป่วยวิกฤต การฟอกไตชนิดไม่ต่อเนื่องโดยใช้ระยะเวลาการฟอกที่นาน (PIRRT) เป็นการฟอกไตชนิดที่นำเอาข้อดีของการฟอกไตชนิดต่อเนื่อง (CRRT) ในด้านการรักษาสมดุลพลศาสตร์การไหลเวียนเลือดและการฟอกไตชนิดดั้งเดิมที่มีราคาถูกเข้าไว้ด้วยกัน การศึกษานี้มีเป้าหมายเพื่อศึกษาผลของการฟอกไตชนิด PIRRT ต่อประสิทธิภาพของการฟอกเลือด และผลลัพธ์ทางพลศาสตร์การไหลเวียนเลือดในผู้ป่วยวิกฤต*

For the SLEDD treatment, the ultrapure dialysis fluid was prepared by stepwise ultrafiltration of water and bicarbonate-containing dialysis fluid using polysulfone ultrafilter (Diasafe® plus). Countercurrent dialysate flows (Qd) for SLEDD were routinely set to 300 ml/min. For SLEDD-*f* treatment, sterile-pyrogen free replacement solution was prepared from on-line hemodiafiltration system of Fresenius 5008 machine. Dialysis purity was guaranteed by regular endotoxin and microbiological testing. Qd of SLEDD-*f* was usually set to 200 ml/min and online-hemodialfiltration (Qf) to 100 ml/min in pre-dilution mode. Standard dialysate in both groups was used with default concentrations as following: Na 138 mmol/L, K 3 mmol/L, Cl 108 mmol/L, HCO_3 28-32 mmol/L, Ca 1.75 mmol/L and Mg 0.5 mmol/L.

Cureus

Open Access Original Article

DOI: 10.7759/cureus.54376

Experience of Sustained Low-Efficiency Dialysis (SLED) in an Intensive Care Unit of a Quaternary Care Hospital

Review began 02/03/2024
Review ended 02/13/2024
Published 02/17/2024

Saleem Sharieff [1, 2], Wajid Rafai [1], Adil Manzoor [3], Asim Idrees [1], Burhan Ahmad [1], Madiha Ghulam [1], Muhammad Usman Shabbir [4]

Conclusion: SLED can be considered as an alternative to CCRT for selected hemodynamically unstable patients requiring renal replacement therapy.

Sustained low-efficiency dialysis (SLED) is a hybrid form of CRRT and intermittent hemodialysis (IHD) with similar clinical outcomes [16]. The session lasts between eight and 16 hours in duration, with slower rates of solute clearance and ultrafiltration than IHD but faster than CRRT [17]. Generally, SLED equipment is the same as used for IHD, although it has lower flow rates for dialysate (350 mL/min) and blood (200 mL/min). The cost of the CRRT program is related to specialized machinery, filters and lines, and filtrate replacement fluid. SLED is at least 10-15% cheaper than CRRT in our setting as per treatment of SLED costs PKR 8500 (equivalent to USD $30) while CRRT costs PKR 150,000 (USD $535) on the first day followed by PKR 85,000/day (USD $330) till new tubing and filter are required, that on average last three days. This means three days of SLED treatment cost $90 vs CCRT cost of $1,195 at our center.

COMPLICATIONS

Hypotension and abnormalities in serum electrolytes, albumin, calcium, and phosphate