

Acute Renal Failure in the Unstable Patient Recent Clinical Experience

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- 14 years old, male.
- Cold Septic Shock
- Purpura fulminans
- MOF
 - Septic shock refractory to fluids and Dopamine
 - Hypoxemia
 - DIC
 - ARF
 - Anuria (18 hours)
 - BUN 60 mg/dL
 - Metabolic acidosis, hyperkalemia (6.3 mEq/L)
 - Shock
 - NS 100 mL/Kg
 - Albumin 5 % 20mL/Kg
 - Dopamine
 - Epinephrine
 - Nitroprusiate
 - Steroids
 - HR: 110 bpm; BP 100/60/73 mmHg CVP: 17 mmHg PWP: 20 mmHg CI: 4.2 L/m/m². LA: 3.2 mMol/L. SvO₂: 65 %



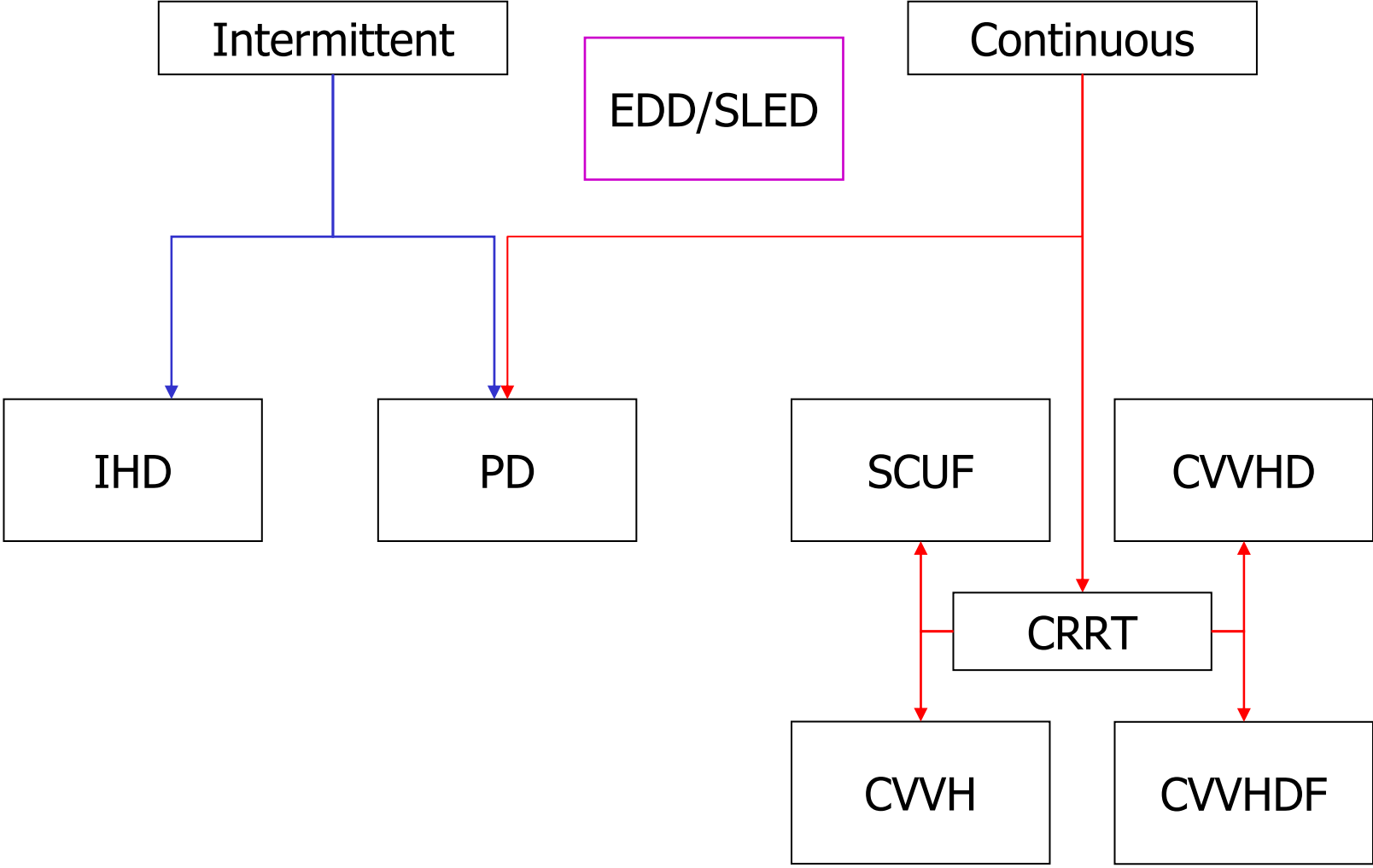
- 4 years old, male.
- 4 days with bloody diarrhea.
- Pallor, oligouria, abdominal pain, vomits, drowsiness, seizures.
- FE: coma (GCS 8), cold shock. HR: 180 bpm, MAP 60/30 mmHg. Temp 39°C. Abdominal tenderness, edema.

- Hematocrit: 18 %. Schizocytes.
- WBC: 25.000 leuc/mm³
- Platelets 55.000/mm³
- BUN: 150 mg/dL
- Creatinine: 1,3 mg/dL
- Na⁺ 130 mEq/L K⁺: 5.1 mEq/L
- pH: 7.25 BE: -10 Bic: 12 mEq/L, pCO₂: 34 (on MV).
- Airway – NS -Antibiotics – Dopamine – Epinephrine.
- Abdominal X Ray: Perforated.
- Diagnosis:
 - HUS
- Surgery: partial colectomy. Transverse colostomy.

- Anuric ARF.
- Metabolic acidosis, hyperkalemia.
- Seizures.
- Hemodynamic unsatability.
- Peritoneum unavailable.

RRT: which one?

RRT Modalities



CRRT is the best option in both cases
Is there any other option?

- Continuous anticoagulation.
- Patient immobility (CT scan, surgery).
- Intensive nursing requirements.
- Costs.

Sustained low-efficiency dialysis Extended Daily Dialysis

- Hybrid therapy between IHD and CRRT.
- Designed for patients hemodynamically unstable (ICU).
- Low efficiency on solute clearances.
- Extended time to increase the dose of dialysis.
- Conventional HD machines.
- Blood pump speeds (QB) and Dialysate flow (QD)

intermediate between IHD & CRRT.

Comparison between IHD, EDD and CRRT

	IHD	EDD/SLED	CRRT
QB (ml/min)	200-300	100-200	100-200
QD (ml/min)	500-800	200-350	15-35
Buffer	Bicarbonate	Bicarbonate	Lactate
Hours/day	4	6-12	24
Days/week	3	6-7	7
Kt/V (daily)	1.2	2.4	0.9-1.4
Costs	+	++	++++

Berbece AN et al. Sustained low-efficiency dialysis in the ICU: cost, anticoagulation, and solute removal. *Kidney Int.* 2006 Sep;70(5):963-8.

Efficacy and cardiovascular tolerability of extended daily dialysis in critically ill children

Minces P, Deltetto N, Coccia P, Pérez A, Eulmesekian P, Ramírez J. Hospital Italiano. Buenos Aires, Argentina

Objective

- To assess the efficacy and cardiovascular tolerability of extended daily dialysis in critically ill children suffering ARF.

Materials and Methods

- Design: retrospective study.
- Setting: multidisciplinary PICU with 18 beds, 900 admissions/year in a general University affiliated hospital.
- Inclusion: all children in ARF on EDD due to cardiovascular instability in whom PD was contraindicated.
- Efficacy: urea reduction rate and UF achieved
- CV tolerability: changes in invasive MAP and HR from baseline values.

Extended Daily Dialysis in a PICU

Table 1. Patients characteristics

N	14
Gender (M/F)	8/6
Age, years (median)	7.0 (range 0.17-21)
PIM2 score (median)	9.4 (range 1.1-33)
Mechanical Ventilation	14
Etiology	
Immunosupressed	10
Acute Hepatic Failure	2
HUS	1
Meningococemia	1
MODS	
4 organs	1
3 organs	8
2 organs	5
Inotropic drugs	
Dopamine & Epinephrine	11
Dopamine	3

Materials and Methods

- HD machine: Fresenius 4008B
- QB: 3 - 5 ml/kg
- QD: 300 ml/min
- Hemodialyzer: polysulfone filters: Fresenius F3, F4, F5
- Filtre SA/Body SA ≤ 1
- Pediatric extracorporeal tubing (< 10 Kg): 22 mL
- Priming: gelatine, albumin, blood
- Days/week: 6

Extended Daily Dialysis in a PICU Results

Table 2. Efficacy

no. of treatments performed per patient *	3.5 (1-21)
QB (mL/min)*	90 (50-120)
Filtre SA/Body SA*	0.9 (0.6-1.6)
Heparin	None
Urea reduction rate*	67.5 (45.5-89) %
UF (%TBW)*	6 (2-9)
Kt/V*	1.09 (0.54-2.2)
Survival	12 (85%)

* Median (range)

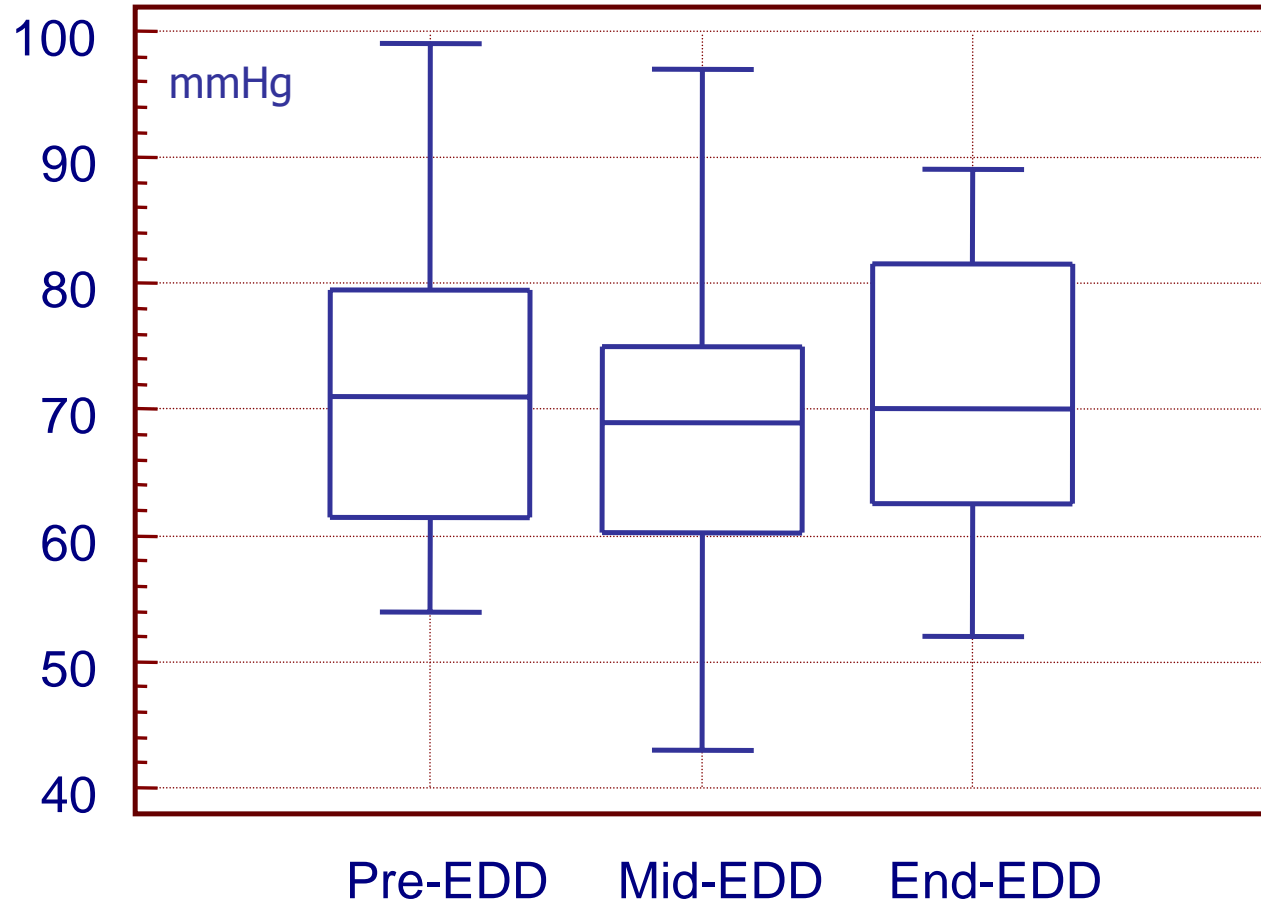
Mean Arterial Pressure, Heart Rate and EDD in Paediatric Critically Ill Patients

Table 3. Cardiovascular tolerability

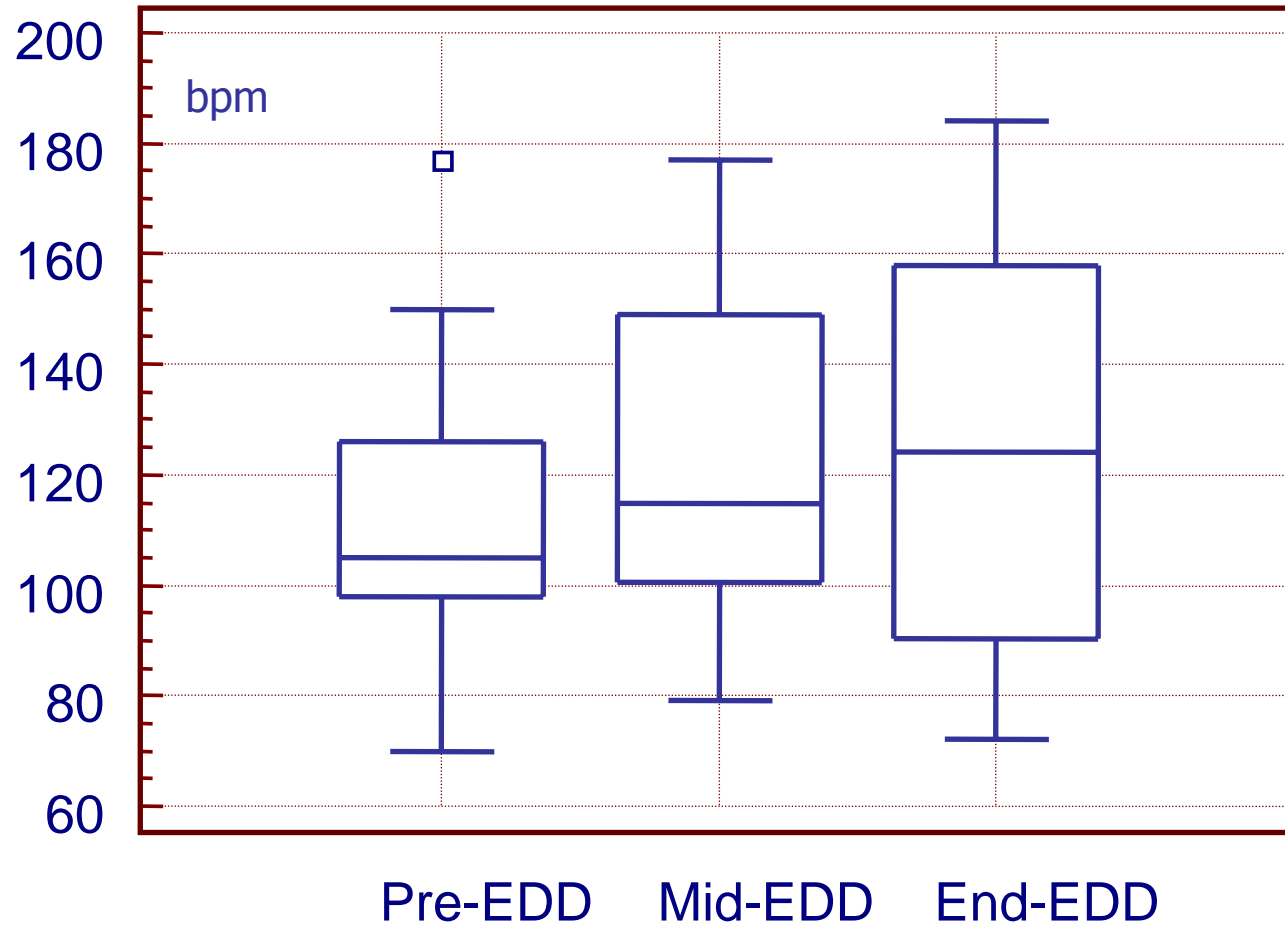
	Pre-EDD	Mid-EDD	End-EDD	p*
MAP (mmHg)	71±12.3	69±14.6	72±11.4	NS
HR (bpm)	114±27	123±33	124±36	NS

Mean Arterial Pressure (MAP) and Heart Rate (HR) just before initiation of Extended Daily Dialysis (Pre-EDD), midway through treatment (Med-EDD) and just after EDD was terminated (End-EDD). There were no significant differences between Med-EDD and End-EDD with respect to Pre-EDD. Mean ± SD. *ANOVA

Blood Pressure



Heart Rate



Efficacy and cardiovascular tolerability of extended daily dialysis in critically ill children

Conclusions

- In this group of critically ill children the EDD efficacy was adequate for urea reduction and ultrafiltration.
- The procedure was hemodynamically well tolerated.

HUS 1981-2007

N= 393

Period	Patients N	Age (yrs) Median (range)	RRT N (%)
1981-1995	271	1.0 (0.25-9)	115 (42.4)
1996-2005	100	2.0 (0.33-10)	47 (47.0)
2006-2007	22	2.4 (0.9-7)	20 (90.9)

- Mortality: 6/393 (1.5%)
 - Severe colonic disease 6
 - Severe CNS disease 4

HUS and EDD

- Age
- Hemodynamic instability
- Severe colonic disease
- Moderate or Severe CNS disease
- Likelihood of Plasma Exchange

Kielstein JT et al. (Hannover) Efficacy & cardiovascular tolerability of extended dialysis in critically ill patients: a RCT. *Am J Kidney Dis* 2004; 43:342-349

•N: 39

	CVVH	EDD (12 hs)	P
N	19	20	NS
Age	50.1 ± 3.2	50.8 ± 3.6	NS
APACHE II	32.3 ± 1.2	33.6 ± 1.0	NS
Sepsis	79 %	85 %	NS
Organ Failure	2.9 ± 0.2	2.9 ± 0.1	NS

Kielstein JT et al. (Hannover) Efficacy & cardiovascular tolerability of extended dialysis in critically ill patients: a RCT. *Am J Kidney Dis* 2004; 43:342-349

Table 2. Serum Urea, Creatinine, and Phosphate Concentrations Before and During Treatment With CVVH and Extended Dialysis

	0 h	12 h	24 h
Serum urea (mg/dL)			
CVVH	83 ± 10	54 ± 6	39 ± 5
Extended dialysis	82 ± 8	38 ± 4*	—
Serum creatinine (mg/dL)			
CVVH	3.48 ± 0.43	2.08 ± 0.20	1.45 ± 0.15
Extended dialysis	3.93 ± 0.40	1.96 ± 0.19	—
Serum phosphate (mg/dL)			
CVVH	6.5 ± 0.6	4.2 ± 0.3	3.4 ± 0.3
Extended dialysis	6.5 ± 0.3	3.7 ± 0.3	—

NOTE. To convert serum urea concentration in mg/dL to mmol/L, multiply by 0.357; serum creatinine concentration in mg/dL to μ mol/L, multiply by 88.4; serum phosphate concentration in mg/dL to mmol/L, multiply by 0.323.

* $P < 0.05$, comparison between CVVH and extended dialysis at 12 hours of therapy.

Kielstein JT et al. (Hannover) Efficacy & cardiovascular tolerability of extended dialysis in critically ill patients: a RCT. *Am J Kidney Dis* 2004; 43:342-349

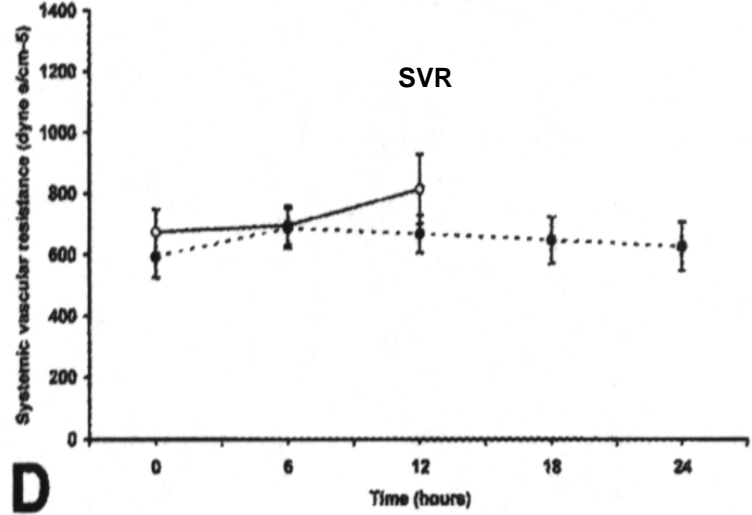
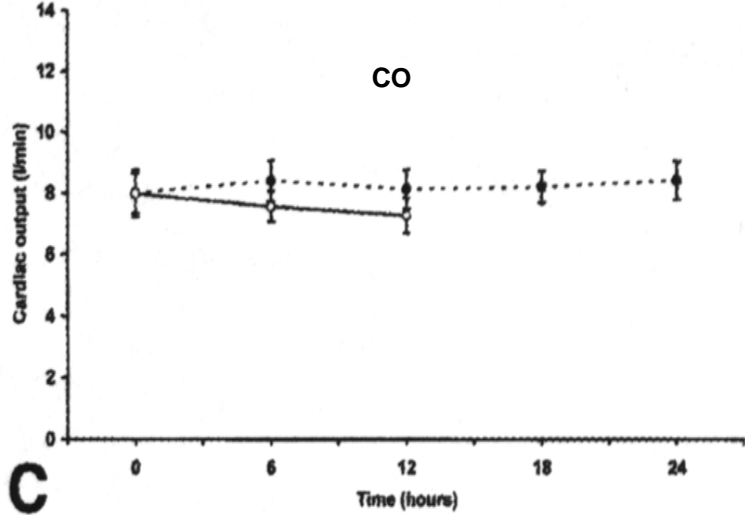
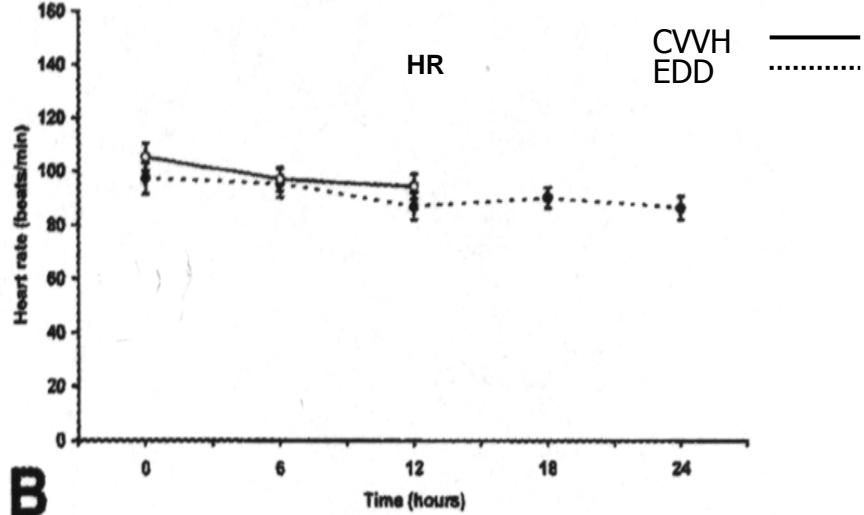
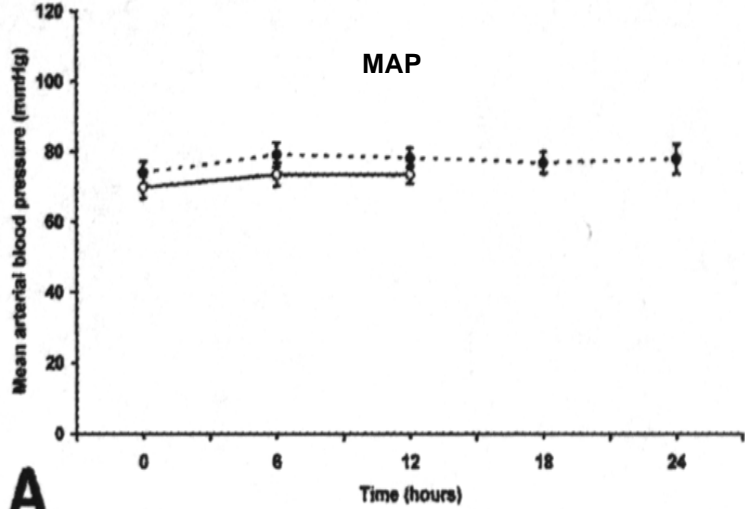
Table 4. Arterial Blood pH and Bicarbonate Concentration Before and During Treatment With CVVH and Extended Dialysis

	Hours				
	0	6	12	18	24
Arterial blood pH					
CVVH	7.30 ± 0.02	7.31 ± 0.03	7.33 ± 0.03	7.35 ± 0.03	7.35 ± 0.03
Extended dialysis	7.31 ± 0.02	7.37 ± 0.02*	7.37 ± 0.02		
Arterial blood bicarbonate (mEq/L)					
CVVH	20.9 ± 0.8	21.6 ± 0.9	22.3 ± 1.0	23.4 ± 1.2	23.7 ± 1.2
Extended dialysis	21.5 ± 1.1	23.8 ± 0.8*	23.9 ± 0.9		

NOTE. To convert bicarbonate in mEq/L to mmol/L, multiply by 1.

**P* < 0.05, comparison between CVVH and extended dialysis at 6 hours of therapy.

Kielstein JT et al. (Hannover) Efficacy & cardiovascular tolerability of extended dialysis in critically ill patients: a RCT. *Am J Kidney Dis* 2004; 43:342-349



Kumar VA et al (Sacramento). Extended daily dialysis: A new approach to RRT for ARF in ICU. *Am J Kidney Dis* 2000; 36: 294-300.

- Retrospective study with control group
- Population: 42 patients (ICU) with ARF

	EDD	CVVH	P
N	25	17	
APACHE II	20.1± 7.9	17.7± 7.3	NS
Median duration of daily treatment (h)	7.5 (6-8) ¹	19.5 (13.4-24) ¹	0.001
Median no. of treatments performed per patient	9 (3-39) ¹	6 (3-15) ¹	NA
Net daily ultrafiltration (mL/d)	3000 (1763-4445) ¹	3028 (1785-4707) ¹	NS
Heparin (U/d)	4000 (0-5800) ²	21000 (8825-31275) ²	0.001

¹ Ranges given for 25th and 75th percentile

² Range

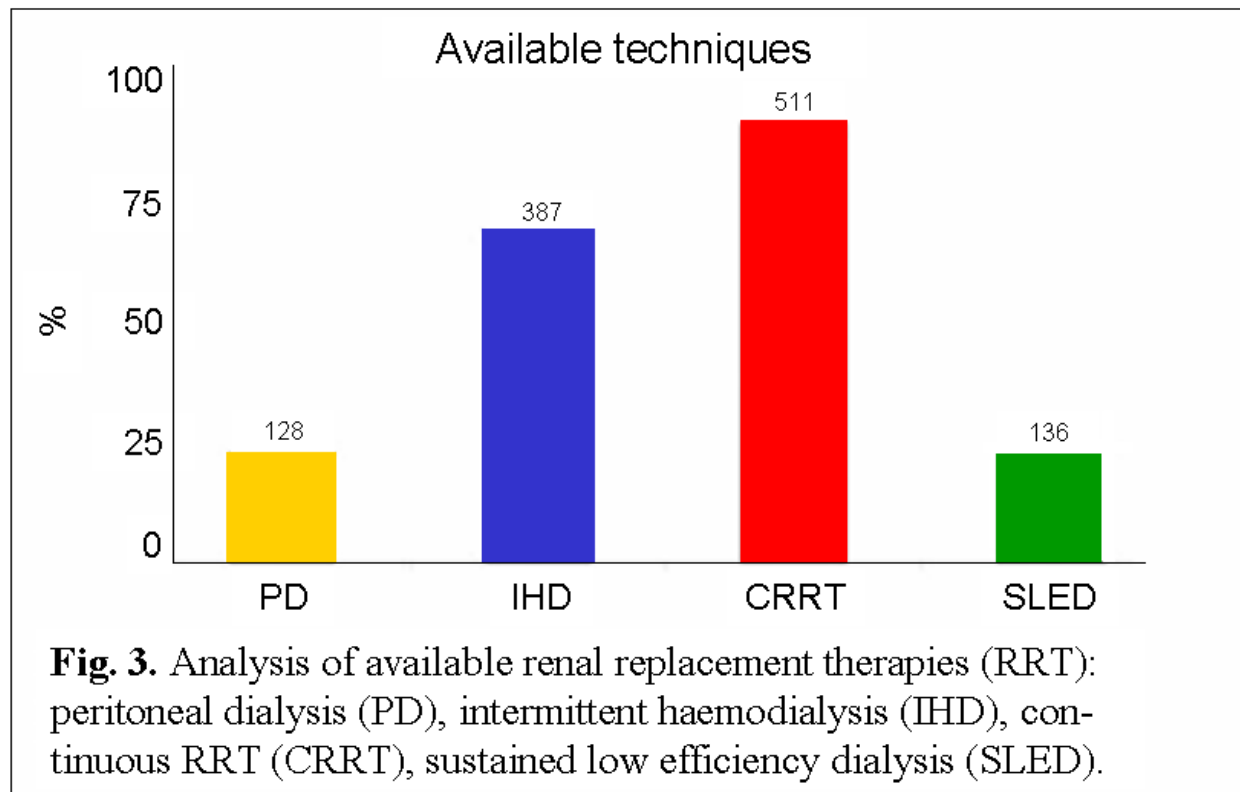
Table 3. Median MAP Just Before Initiation of Treatment, Midway Through Treatment, and Just Before Treatment Was Terminated

	CVVH	EDD	P
Pre-MAP (mm Hg)	67 (61.8-77.3)	70 (62-83.8)	NS
Mid-MAP (mm Hg)	68 (61-77)	70 (63-80)	NS
End-MAP (mm Hg)	69 (60.8-78)	71 (63-83)	NS

NOTE. Ranges given for 25th and 75th percentile.
Abbreviation: NS, not significant.

Kumar VA et al. *Am J Kidney Dis* 2000; 36: 294-300.

Practice patterns in the management of acute renal failure in the critically ill patient: an international survey.



Ricci Z et al. Nephrol Dial Transplant (2006) 21: 690–696

In summary

- SLED/EDD could be considered as an alternative to CRRT and PD in hemodynamically unstable patients in ARF.
- It is as effective as CRRT.
- Lower dose of heparin is necessary to be used.
- There is insufficient data to recommend its use widely in small children.



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