Συνδυασμός τεχνικών αφαίρεσης με μεθόδους κάθαρσης-Προοπτικές

Θεόδωρος Ελευθεριάδης
Επικ. Καθ. Νεφρολογίας
Τμήμα Ιατρικής
Πανεπιστήμιο Θεσσαλίας

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Original Article

NDT
Nephrology Dialysis Transplantation

Tandem plasmapheresis and haemodialysis as a safe procedure in 82 patients with immune-mediated disease

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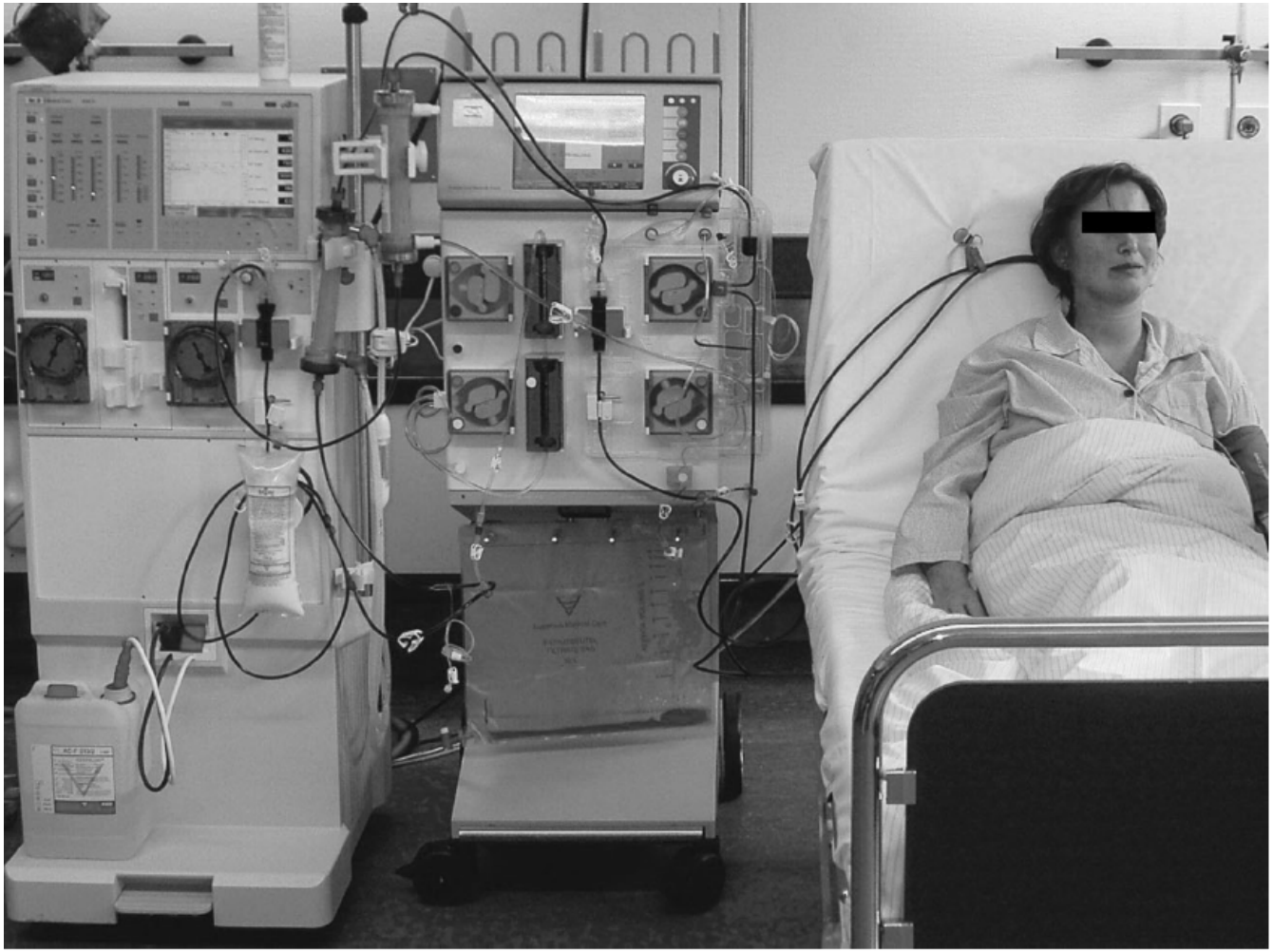

Table 1. The clotting parameters and bleeding risk corresponding to the heparin dose

Heparin	Thrombocytes	Quick/INR	Fibrinogen	Bleeding active/risk
No heparin	<40 000/µl	<30%/>2.	<100	Active bleeding
Low-dose heparin 10 IU/kg BW/h	40 000–60 000/µl	30–50%/0.8–2.0	100–150	Elevated risk
Optimal dose heparin 25 IU/kg BW/h	>60 000/µl	>50%/<0.8	>150	No risk

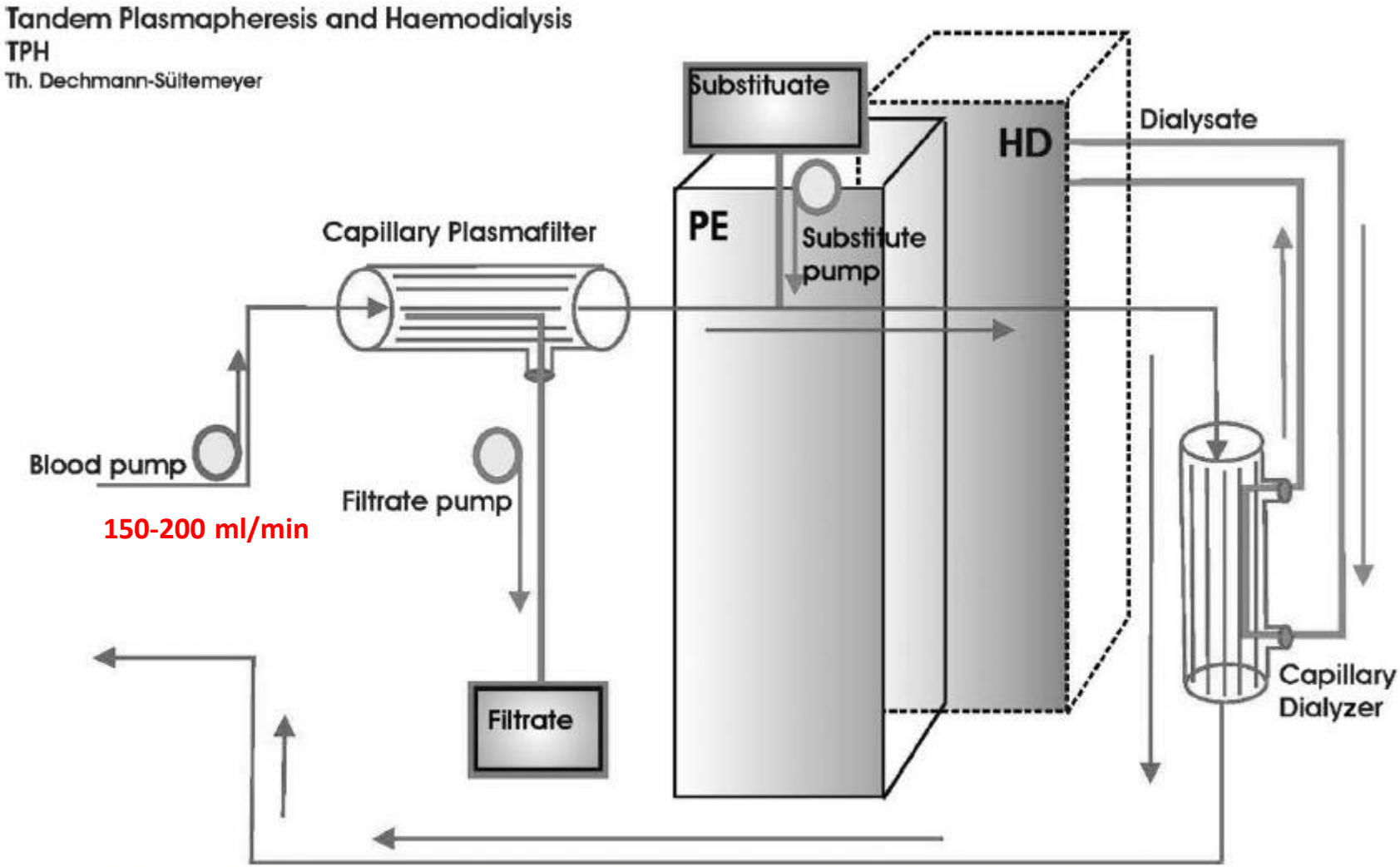

Fig. 2. Simplified graphical presentation of the blood, substituate, dialysate and plasma circuit during tandem plasmapheresis—haemodialysis.

***Ρυθμός ανταλλαγής πλάσματος + Υπερδιήθηση < 25% της ροής αίματος**

Table 2. Number of patients and treatments with tandem plasmapheresis–haemodialysis depending on disease that were treated at the hospital between 1990 and 2006

Disease	Number of patients	Sex (male/female)	Age (years) (mean ± SD median, min–max)	Number of treatments (mean range)	Outcome: with kidney function/dialysis dependence	Death
Thrombotic microangiopathy	38	12/26	41 ± 17 37 19–80	6.4 ± 3.7 1–16	15/23	0
Vasculitis with rapid progressive kidney disease	27	21/6	54 ± 15* 55 21–82	6 ± 3 1–13	16/11	0
Goodpasture's disease	5	5/0	29 ± 12* 29 19–48	6 ± 4.8 1-8	3/2	0
Plasmocytoma with hyperviscosity	5	4/1	68 ± 10* 74 52–76	4.6 ± 3.5 3–10	3/2	5**
Cold reactive antibodies and acute renal failure	1	1/0	28*	1	1/0	0
Humoral rejection after kidney transplant	6	4/2	40 ± 7 40 29–49	5 ± 5 2–16	3/3	1
Total	82	47/35	46 ± 17 42 19–82	483 5.9 ± 3.6	41/41	6

*$P < 0.01$ as compared to HUS/TTP.
**$P < 0.001$.

1. There were no life-threatening complications or side effects that could be traced back to the treatment procedure.
2. The balance goals were achieved; no back-filtration occurred. Controls were performed by checking body-weight both before and after treatment.
3. The electrolyte and acid–base balance were instantly normalized during the procedure.
4. With simultaneous ultrafiltration, over-hydrated patients with pulmonary congestion underwent plasma separation without problems. There were no cases of fluid displacement from the intra-alveolar to the extra-alveolar space. Breathing problems were quickly relieved and exhaustion prevented.
5. Calcium displacement and enlargement of anion gaps caused by the citrate as occur under high-volume fresh plasma substitution were directly brought into balance by haemodialysis. No calcium had to be substituted.
6. For diseases involving cold-reactive antibodies, the blood temperature was held constant and further haemolysis prevented.

Aside from the medical advantages, the procedure was basically well tolerated by the patients. Some patients, who experienced sequential treatment in earlier years, were welcoming the obvious decrease in treatment time. Total treatment and preparation time—in comparison to conventional procedures—was reduced from 5.75–6.5 h to 3.5–4.0 h. This meant that the dialysis unit's space and personnel could be used optimally. However, there were no material savings.

Hemodialysis International 2012; ••:••–••

Combination hemodialysis and centrifugal therapeutic plasma exchange: 18 years of Canadian experience

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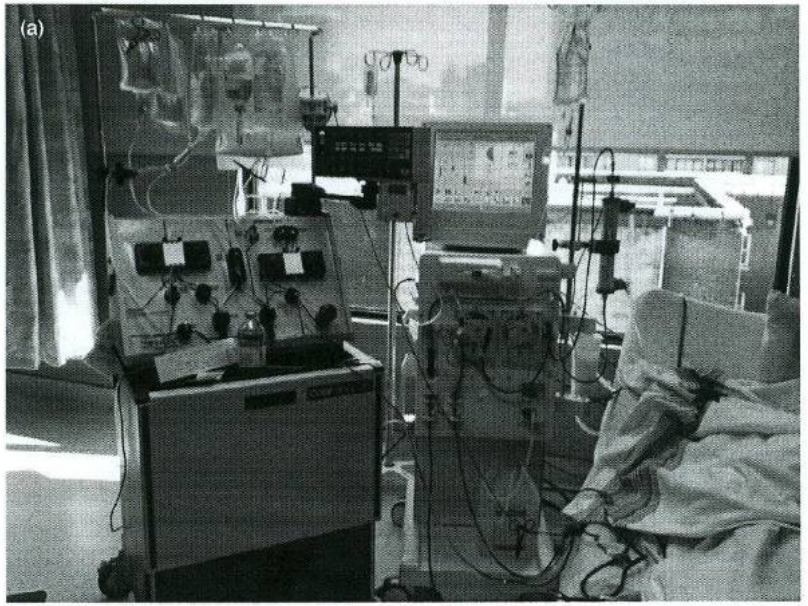

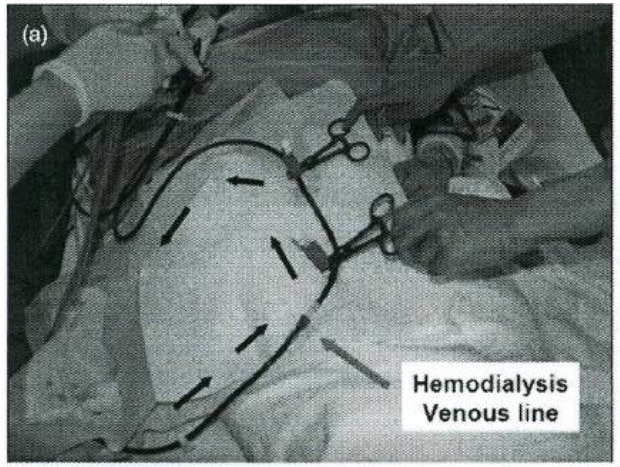

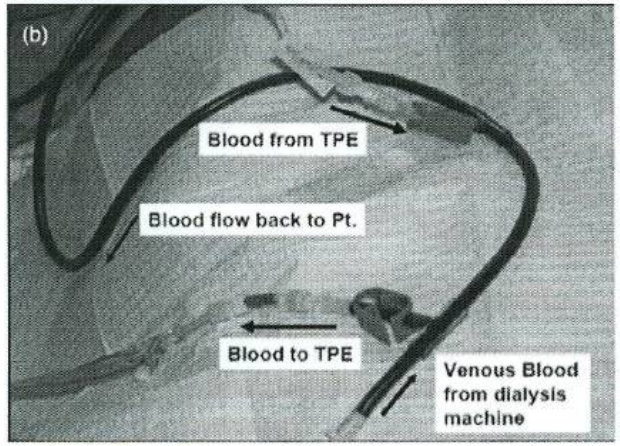

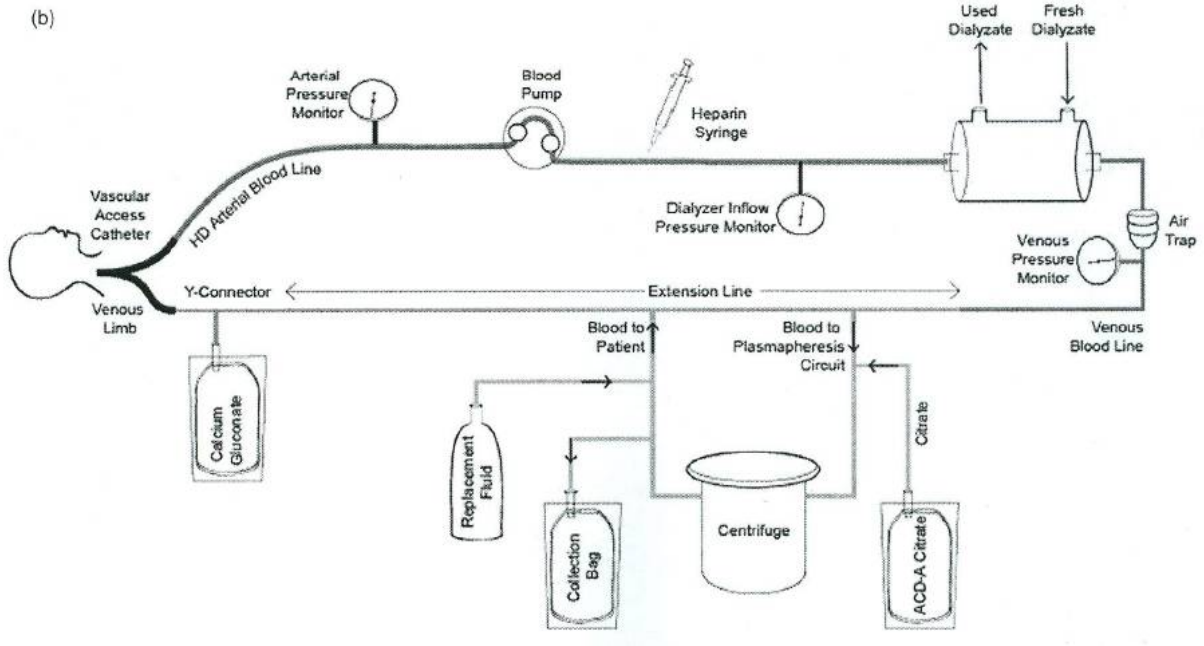

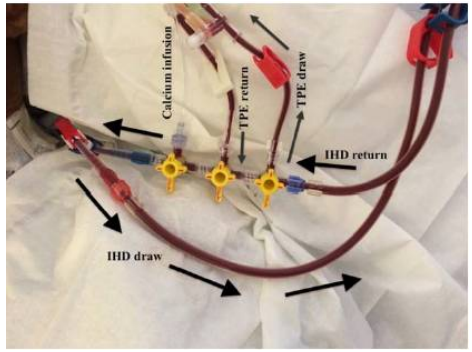

McAlister, Hemodialysis Int, 2016

Table 1 Treatment parameters of combination treatment prescription. Components of individual hemodialysis and therapeutic plasma exchange prescriptions during combination treatments

	Hemodialysis circuit	Therapeutic plasma exchange circuit
Treatment time	4 h	Dependent on exchange volume Typically 1.5–3 h
Whole blood flow rate	As per routine orders (usually 300–350 mL/min)	Determined by target plasma removal rate (up to 120 mL/min)
Plasma removal rate	—	Maximum 60 mL/min
Fluid removal rate	As per patient clinical status	—
Anticoagulation	Unfractionated heparin • infused into arterial HD line	Citrate (ACD-A) • infused into TPE inlet line • ratio to inlet blood flow rate 1:25 (standard) 1:35 (if using FFP as replacement) 1:45 (if hypocalcemic) • infusion rate range 0.8–1.2 mL/min/L of EV
Calcium	1.25–1.5 mmol/L in dialysate	Calcium gluconate 1–2 g/h peripheral intravenous infusion
Bicarbonate	28–35 mmol/L in dialysate	—
Plasma volume (PV)	—	0.07 × weight (kg) × (1-hematocrit)
Exchange volume (EV)	—	1.5 × PV (first 3–5 treatments), then 1.0 × PV (subsequent treatments)
Replacement volume	—	100%
Exchange fluid	—	100% plasma (if HUS/TTP) or 75% albumin (5%) + 25% Ringer's lactate or normal saline

ACD-A = Anticoagulant Citrate Dextrose Solution-Formula A; EV = exchange volume; FFP = fresh frozen plasma; HD = hemodialysis; HUS = hemolytic uremic syndrome; TPE = therapeutic plasma exchange; TTP = thrombotic thrombocytopenic purpura.

Indication for therapeutic plasma exchange	Total patients (n)	Males (n/total) (%)	Age in years (avg) (range)	Total number treatments (n)	Renal recovery (n/total) (%)	In-hospital death (n/total) (%)	Overall death (n/total) (%)
Goodpasture's/anti-GBM disease	24	14/24 (58)	55.5 (28–78)	228	3/24 (13)	0/24 (0)	6/24 (25)
TTP/HUS	24	11/24 (46)	54.8 (17–81)	123	14/24 (58)	1/24 (4)	8/24 (33)
Vasculitis	25	13/25 (52)	60.1 (30–80)	191	12/25 (48)	1/25 (4)	1/25 (4)
Renal transplant	8	6/8 (75)	44.1 (34–65)	18	7/8 (88)	0/8 (0)	3/8 (38)
Multiple myeloma	4	2/4 (50)	67.8 (54–87)	26	2/4 (50)	0/4 (0)	0/4 (0)
Other or unknown	7	4/7 (57)	26.0 (18–33)	35	2/7 (29)	0/7 (0)	1/7 (14)
Overall	92	51/92 (55)	51.3 (18–87)	621	41/92 (45)	2/92 (2)	19/92 (21)

anti-GBM = antiglomerular basement membrane; HUS = hemolytic uremic syndrome; TTP = thrombotic thrombocytopenic purpura.

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CLINICAL STUDY

Tandem Plasmapheresis and Hemodialysis: Efficacy and Safety

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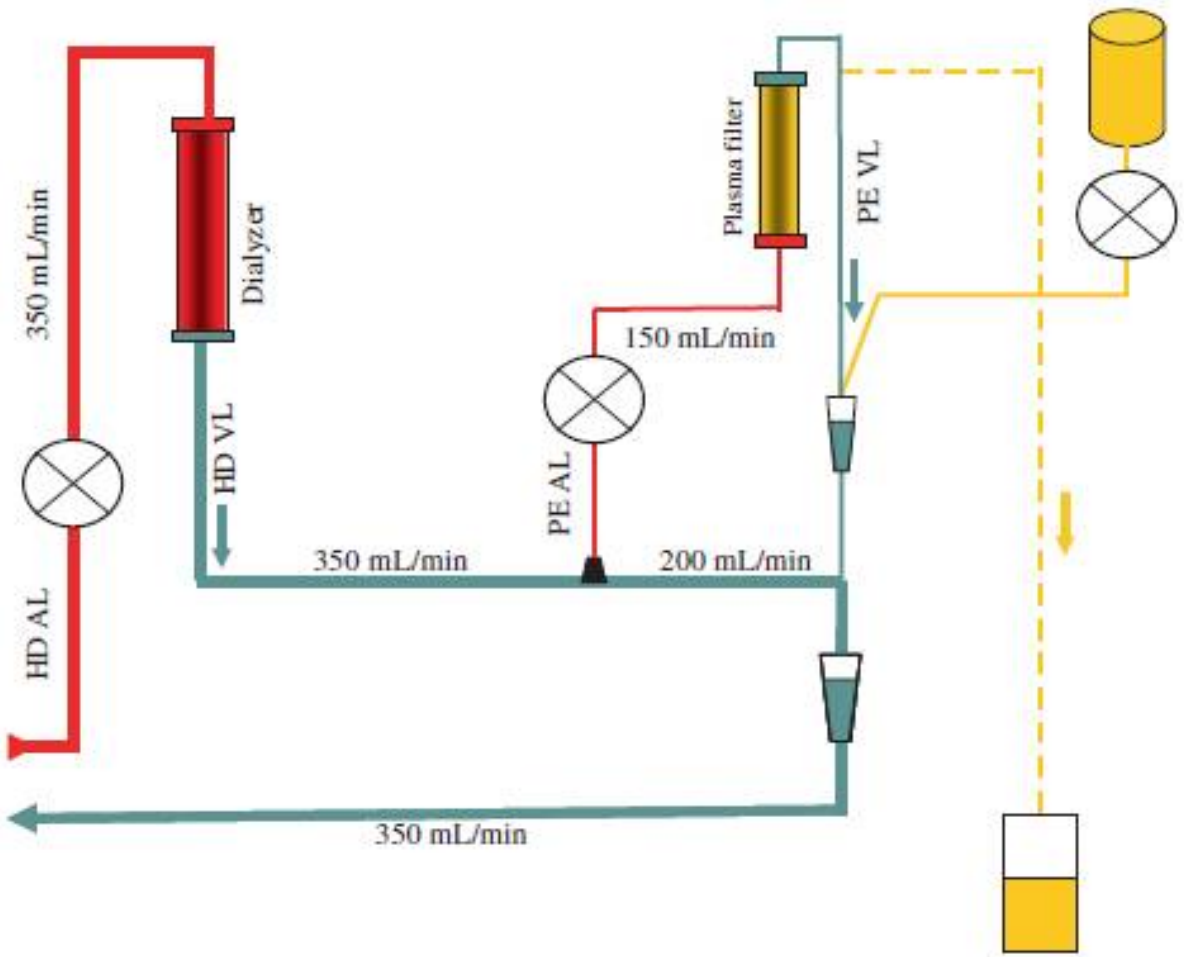


Anticoagulation

Anticoagulation of the extracorporeal circuit was performed with an initial bolus of 1% sodium heparin (mean 21 ± 16 mg per session). No additional heparin was used when the PE system was started.

We performed an observational study of 36 patients who were treated with a total of 287 TPH sessions between January 1998 and February 2010 in our center.

Etiology	HD dependent	HD independent
TMA	1	2
RPGN	11	10
AHR	4	2
Goodpasture's syndrome	6	0
Total	22 (61.1%)	14 (38.9%)

	Number of episodes (% total of sessions)	Number of episodes (% sessions with FFP)	Number of episodes (% sessions with PLP)
Minor adverse events			
Pruritus	3 (1.04)	2 (2.53)	1 (0.48)
Rash	1 (0.35)	0	1 (0.48)
Nausea and/or vomiting	2 (0.69)	1 (1.26)	1 (0.48)
Paresthesias	2 (0.69)	2 (2.53)	0
Headache	1 (0.35)	0	1 (0.48)
Chest pain	4 (1.39)	2 (2.53)	2 (0.96)
Dyspnea	4 (1.39)	2 (2.53)	2 (0.96)
Hypotension	11 (3.83)	2 (2.53)	9 (4.33)
Extracorporeal circuit clotting	2 (0.69)	1 (1.26)	1 (0.48)
Total	30 (10.45)	12 (15.19)	18 (8.65)

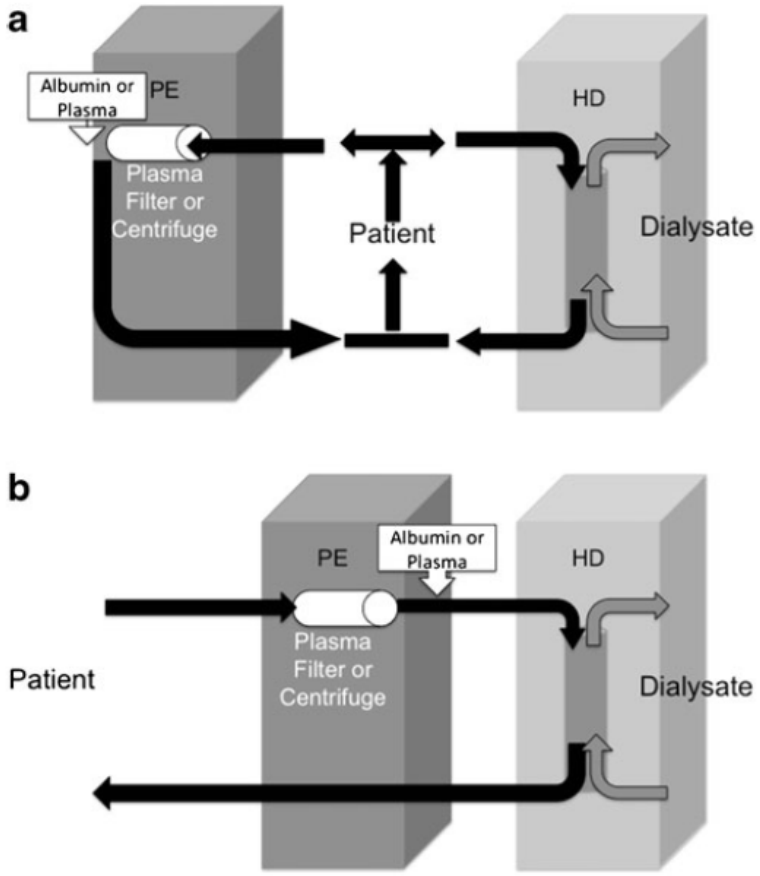
Note: PE, plasmapheresis; HD, hemodialysis; FFP, fresh frozen plasma; PLP, purified lyophilized plasma.

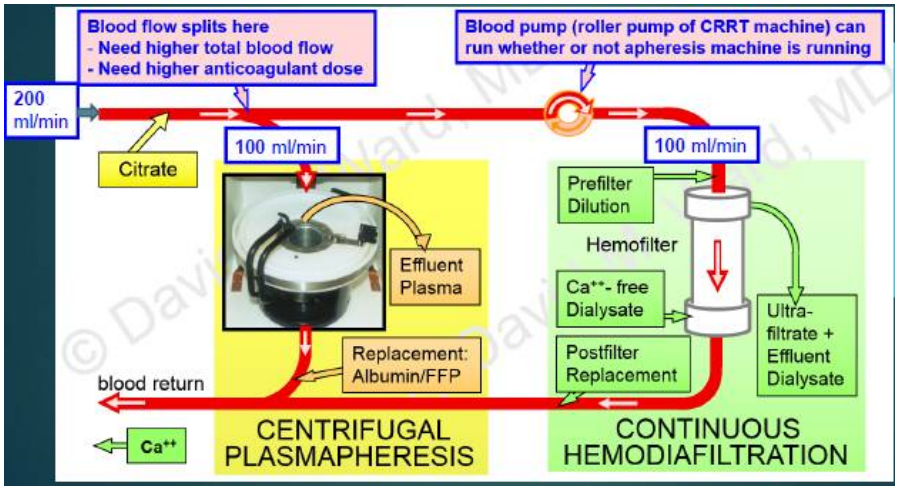
Pediatr Nephrol
DOI 10.1007/s00467-013-2620-7

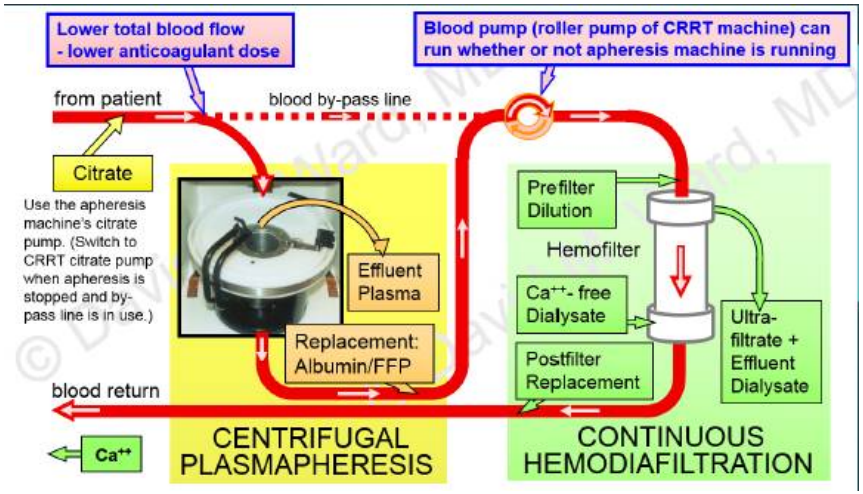
REVIEW

Tandem hemodialysis and plasma exchange

Guido Filler · William F. Clark · Shih-Han S. Huang







Safety and Efficacy of Tandem Hemodialysis and Plasma Exchange in Children

Betti Schaefer, Akos Ujszaszi,† Susanne Schaefer,* Karl Heinz Heckert,* Franz Schaefer,* and Claus Peter Schmitt**

Clin J Am Soc Nephrol 9: 1563–1570, 2014

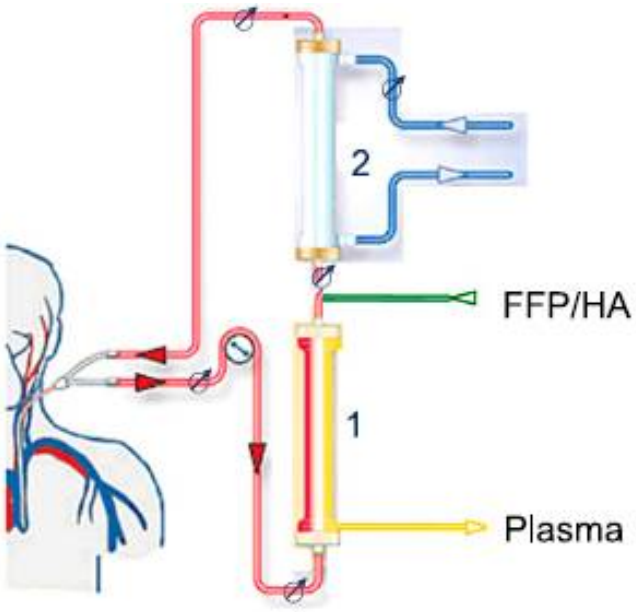


Table 1. Patient characteristics

Characteristic	cPE/HD (*n*=15)	sPE/HD (*n*=21)	Both cPE/HD+sPE/HD (*n*=11)
Age (yr)	5.0 (3.1–12.2)	6.5 (3.2–12.6)	7.4 (2.1–16.6)
Sex (men/women)	9/6	15/6	7/4
Weight (kg)	19.4 (13.5–35.5)	25.5 (15.7–49.8)	31.0 (17.8–51.8)
Underlying disease			
HUS	7	9	1
Liver failure	8	14	7
Wegener's granulomatosis	2	3	0
Kidney transplant rejection	2	2	1
FSGS	1	1	0
FSGS recurrence	1	1	1
Nephronophthisis	1	0	0
Dense deposit disease	1	0	0
SLE	1	1	1
Steroid-dependent nephrotic syndrome	0	1	0
Ornithine transcarbamylase deficiency	1	0	0
Unknown	1	0	0

Data are presented as the median (interquartile range) or *n*. HUS, hemolytic uremic syndrome; cPE/HD, combined PE/HD; PE, plasma exchange; HD, hemodialysis; sPE/HD, sequential PE/HD.

Table 2. Treatment modalities in all 47 children undergoing cPE/HD, sPE/HD, or both

Modality	Combined Sessions (n=92)			Sequential Sessions (n=113)		
	PE	HD	PE/HD	PE	HD	PE/HD
Treatment duration (h)	2.5 (2.0, 3.0)	3.0 (2.3, 3.8)	3.0 (2.5, 4.0)	2.0 (1.8, 2.3)[a]	3.3 (2.5, 4.0)	5.4 (4.5, 6.0)[a]
Filter surface area (m^2/m^2 BSA)	0.38 (0.30, 0.46)	0.91 (0.70, 1.07)		0.45 (0.41, 0.57)	0.86 (0.72, 0.95)	
Blood flow (ml/min per m^2)			100 (86, 124)	88 (80, 104)[a]	111 (96, 137)[b]	
Dialysate flow (ml/min per m^2)		467 (373, 656)			301 (233, 378)[a]	
Initial dose of heparin (IU/m^2)			935 (0, 1867)	0 (0, 430)[a]	0 (0, 603)[a]	580 (0, 949)[a]
Continuous dose of heparin (IU/m^2 per h)			427 (321, 503)	374 (171, 645)	389 (229, 522)	
Total continuous dose of heparin (IU/m^2)			1227 (833, 1790)	765 (374, 1225)[a]	1056 (618, 1837)[b]	2064 (1033, 2697)
Heparin boli (IU/m^2)			362 (0, 757)	246 (0, 402)[a]	0 (0, 350)	343 (164, 890)
Total dose of heparin (IU/m^2 per session)			2939 (1868, 4189)	1260 (656, 2019)[a]	1847 (1103, 2498)[a,b]	3341 (2126, 4792)
Mean ACT (s)			150(120, 270)	141 (125, 198)	142 (128, 177)	148 (130, 180)
ACT first 20 min (s)			281 (170, 353)	146 (131, 207)	199 (156, 301)	
Citrate (g/m^2 per h)			3.0±0.9	2.7±0.9	3.3±0.9	
Calcium (g/m^2 per h)			0.8 (0.4, 1.9)	1.2 (0.9, 1.7)	1.2 (0.7, 1.9)	
Ultrafiltration (ml/m^2)		743 (302, 1470)			985 (559, 1581)	
Plasma exchanged (ml/m^2)	1967 (1524, 2384)			1943 (1524, 2200)		

Data are presented as the median (interquartile range). BSA, body surface area; ACT, activated clotting time.
[a]$P<0.05$ versus respective combined treatment.
[b]$P<0.05$ sequential PE versus sequential HD.

Table 4. Dialysis efficacy (all children)

Laboratory parameters	Before cPE/HD	After cPE/HD	Δ (%)	Before sPE/HD	After sPE/HD	Δ (%)
Serum creatinine (mg/dl)	2.9 (1.5, 3.9)	0.9 (0.7, 1.8)	−38 (−45, −4)	3.3 (1.7, 5.4)	1.3 (0.9, 2.3)	−33 (−49, −19)
Serum urea (mg/dl)	142 (49, 178)	35 (14, 76)	−43 (−55, −37)	126 (67, 179)	75 (50, 109)	−40 (−53, −24)
Serum phosphate (mg/dl)	5.0 (2.8, 6.2)	2.8 (2.8, 3.1)	7 (−23, 26)	5.6 (4.6, 6.5)	4.3 (2.8, 5.0)	−32 (−47, −4)
INR	1.6 (1.2, 2.0)	1.3 (1.2, 1.4)	−23 (−33, −13)	1.2 (1.1, 1.9)	1.2 (1.1, 1.5)	−14 (−35, −3)
Serum total bilirubin (mg/dl)	18.8 (4.9, 30.9)	17.7 (12.8, 20.0)	−33 (−42, −24)	12.3 (4.7, 25.4)	8.9 (5.4, 22.5)	−33 (−50, −24)
Serum direct bilirubin (mg/dl)	9.7 (4.1, 17.3)	6.9 (4.6, 8.8)	−37 (−50, −31)	8.8 (2.1, 15.4)	8.1 (5.1, 14.5)	−37 (−52, −25)
Serum ammonia (μg/dl)	122 (53, 245)	137 (115, 193)	−27 (−32, −24)	152 (113, 249)	92 (50, 134)	−51 (−67, −37)

Data are presented as the median (interquartile range). INR, international normalized ratio.

Table 5. Adverse events (all children)

Event	cPE/HD (*n*=92 Sessions)	sPE/HD (*n*=113 Sessions)	*P* Value
Dialysis procedure-related problems			
Blood leak/hemolysis	8	4	
Clotting	5	2	
High venous pressure	0	2	
Total number	13 (14.1)	8 (7)	0.37
Adverse events in patients			
Allergic reaction (itching/exanthema)	4	2	
Abdominal pain	3	1	
Headache	3	1	
Freezing sensation	0	1	
Convulsion	1	1	
Muscle cramp	1	0	
Nausea/vomiting	5/1	1/0	
Total number	18 (19.6)	7 (6.2)	0.05
All adverse events	31 (33.7)	15 (13.3)	0.05
Dialysis sessions discontinued	11	6	0.14
Dialysis related	8	6	
Patient related	3	0	

Data are presented as *n* or *n* (%).

ΜΟΝΑΔΑ ΤΕΧΝΗΤΟΥ ΝΕΦΡΟΥ – ΝΕΦΡΟΛΟΓΙΚΗ ΚΛΙΝΙΚΗ – ΠΑΝΕΠΙΣΤΗΜΙΟΥ ΘΕΣΣΑΛΙΑΣ

Πλασμαφαιρέσεις 2018

- **Νεφρολογική κλινική → 92**
- **Νευρολογική κλινική → 105**
- **Αιματολογική κλινική → 79**
- **Ρευματολογική κλινική → 12**
- **Παθολογική κλινική → 3**

Σύνολο → 291

92 x 3 = 276 ώρες = 34,5 8ωρα

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Case Report

Tandem plasmapheresis with hemodialysis in phenytoin intoxication: a case report

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ORIGINAL ARTICLE

Open Access

Immunoadsorption and hemodialysis as a tandem procedure: a single-center experience of more than 60 procedures

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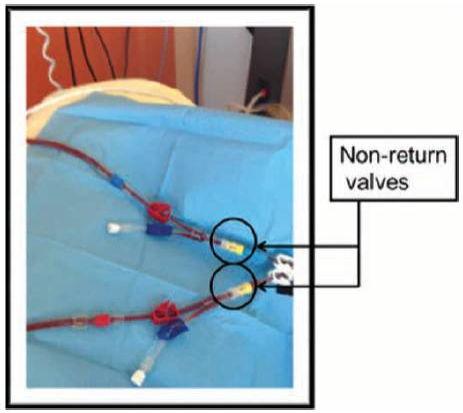
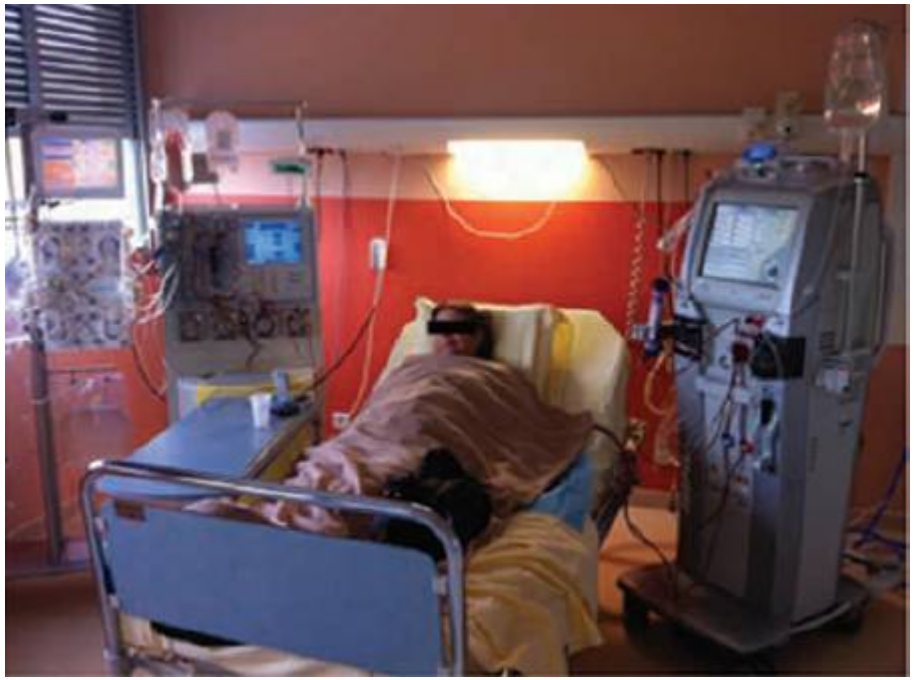
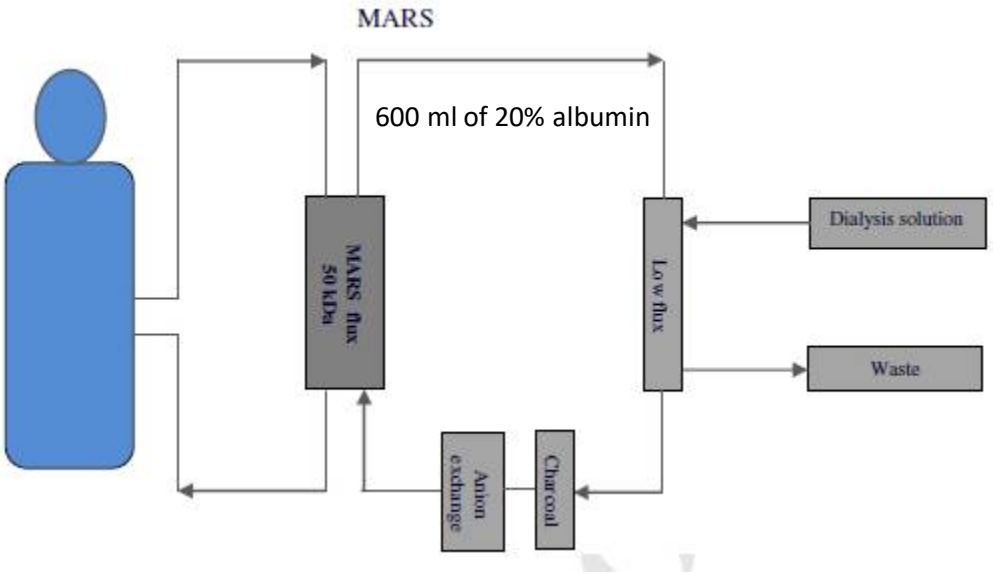
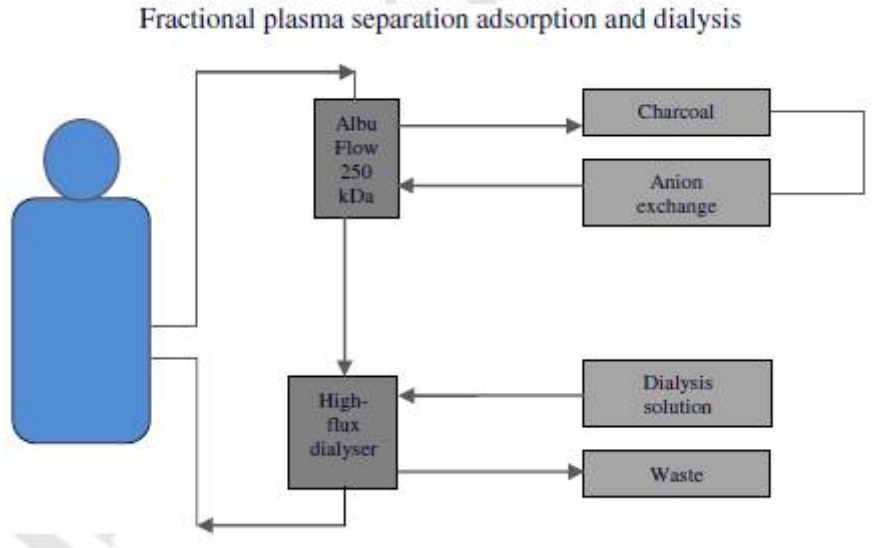


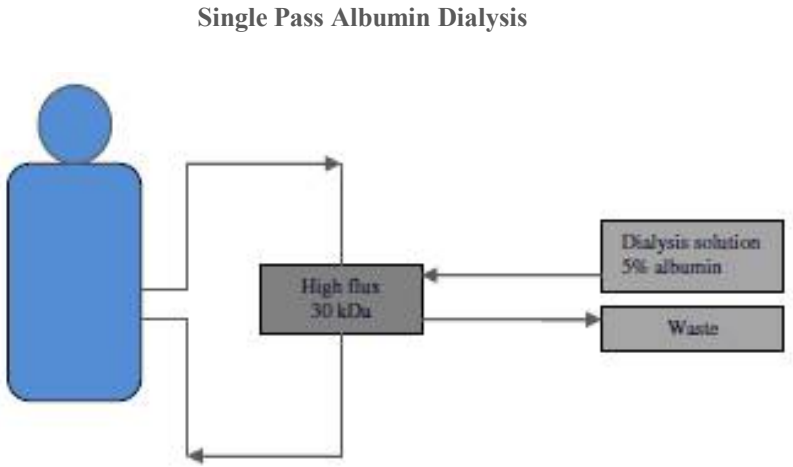




- Ελαττώνει τη χολερυθρίνη
- Ελαττώνει το χαλκό σε ν. Wilson
- Βελτιώνει την εγκεφαλοπάθεια
- Βελτιώνει τον κνησμό
- Βελτιώνει τη νεφρική λειτουργία
- Βελτιώνει τη εγκεφαλική αιμάτωση
- Χειροτερεύει την πήξη του αίματος
- Υπογλυκαιμία
- Επιβίωση?



- Καλύτερο από MARS στη πηκτικότητα
- Χειρότερο από MARS στην ΑΠ
- Μικρή εμπειρία



- Απλή και σχετικά φθηνή
- Ισότιμη με MARS για τη χολερυθρίνη
- Άλλες παράμετροι?

Maiwall, Heptol Int 2014

Systematic review and meta-analysis of survival following extracorporeal liver support

B. M. Stutchfield[1], K. Simpson[2] and S. J. Wigmore[1]

Reference	Acute liver failure ELS	Acute liver failure SMT	Weight (%)	Risk ratio
Demetriou *et al.*[5]	20 of 73	30 of 74	57·8	0·68 (0·42, 1·08)
El Banayosy *et al.*[14]	7 of 14	9 of 13	30·7	0·72 (0·38, 1·37)
Ellis *et al.*[13]	4 of 12	5 of 12	11·5	0·80 (0·28, 2·27)
Total	31 of 99	44 of 99	100·0	0·70 (0·49, 1·00)

Heterogeneity: $\tau^2 = 0{\cdot}00$; $\chi^2 = 0{\cdot}09$, 2 d.f., $P = 0{\cdot}95$, $I^2 = 0\%$
Test for overall effect: $Z = 1{\cdot}95$, $P = 0{\cdot}05$

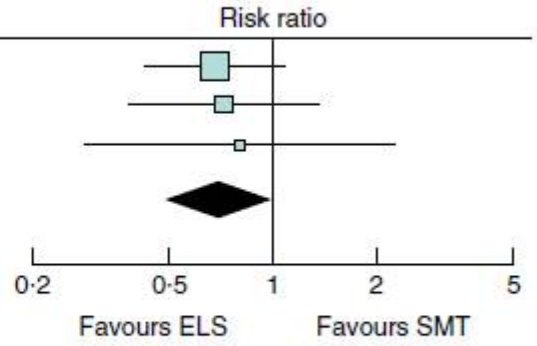


Fig. 2 Forest plot showing risk ratio with 95 per cent confidence interval for individual studies comparing extracorporeal liver support (ELS) with standard medical therapy (SMT) in acute liver failure. The Mantel–Haenszel random-effects method was used

Reference	Acute-on-chronic liver failure ELS	Acute-on-chronic liver failure SMT	Weight (%)	Risk ratio
Ellis *et al.*[18]	5 of 5	5 of 5	34·7	1·00 (0·71, 1·41)
Hassanein *et al.*[4]	19 of 39	17 of 31	26·3	0·89 (0·56, 1·40)
Heemann *et al.*[15]	1 of 12	7 of 11	2·5	0·13 (0·02, 0·90)
Mitzner *et al.*[17]	6 of 8	5 of 5	25·1	0·79 (0·49, 1·26)
Sen *et al.*[16]	5 of 9	5 of 9	11·4	1·00 (0·44, 2·29)
Total	36 of 73	39 of 61	100·0	0·87 (0·64, 1·18)

Heterogeneity: $\tau^2 = 0{\cdot}04$; $\chi^2 = 6{\cdot}20$, 4 d.f., $P = 0{\cdot}18$, $I^2 = 35\%$
Test for overall effect: $Z = 0{\cdot}89$, $P = 0{\cdot}37$

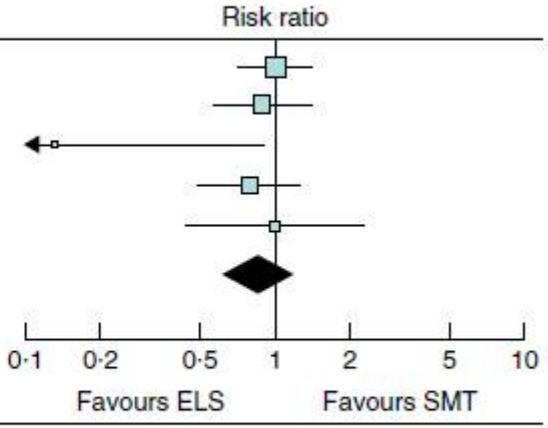


Fig. 3 Forest plot showing risk ratio with 95 per cent confidence interval for individual studies comparing extracorporeal liver support (ELS) with standard medical therapy (SMT) in acute-on-chronic liver failure. The Mantel–Haenszel random-effects method was used

FDA Clearance (US only)

• Federal Drug Administration (FDA) cleared, in a document dated on May 27, 2005, MARS therapy for the treatment of **drug overdose and poisoning.** The only requirement is that the drug or poison must be susceptible to be dialysed and removed by activated charcoal or anionic exchange resins.

• More recently, on December 17, 2012, MARS therapy has been cleared by the FDA for the treatment of **hepatic encephalopathy due to a decompensation of a chronic liver disease.** Clinical trials conducted with MARS treatment in HE patients having a decompensation of chronic liver disease demonstrated a transient effect from MARS treatments to significantly decrease their hepatic encephalopathy scores by at least 2 grades compared to standard medical therapy (SMT).

• The MARS **is not indicated as a bridge to liver transplant**. Safety and efficacy has not been demonstrated in controlled, randomized clinical trials.

• The effectiveness of the MARS device in patients that are sedated could not be established in clinical studies and therefore cannot be predicted in sedated patients

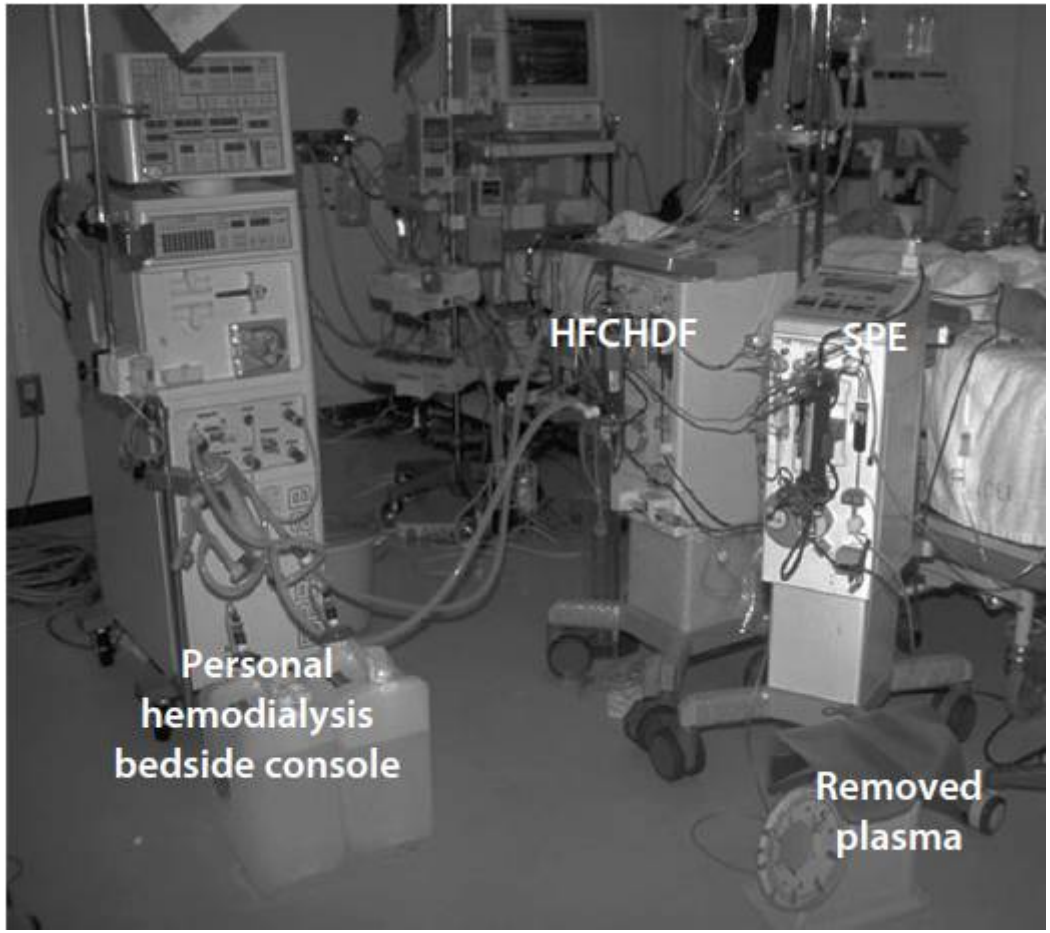
Suzuki H, Hirasawa H (eds): Acute Blood Purification.
Contrib Nephrol. Basel, Karger, 2010, vol 166, pp 64–72

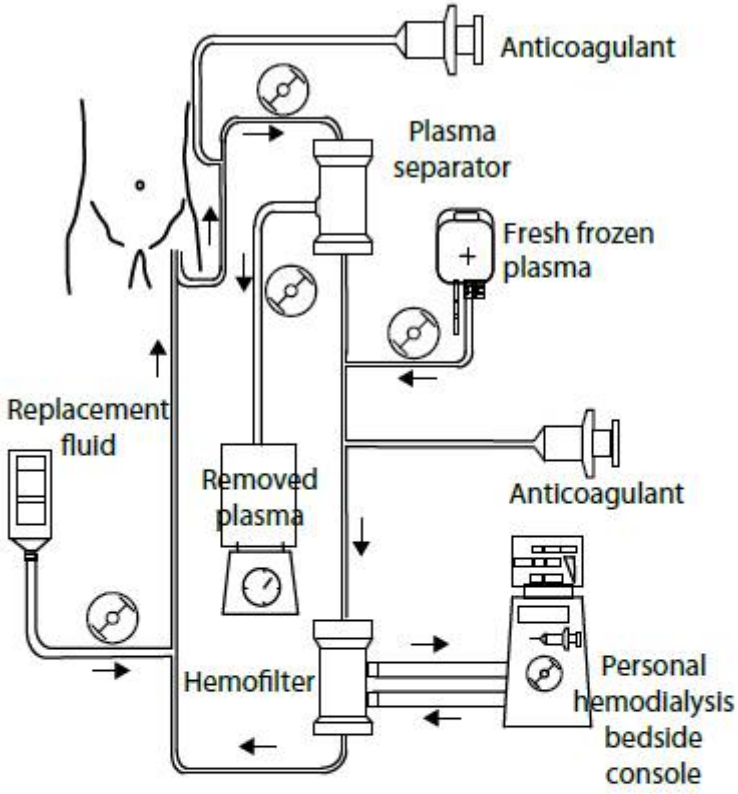
Blood Purification in Fulminant Hepatic Failure

Koichiro Shinozaki · Shigeto Oda · Ryuzo Abe · Yoshihisa Tateishi · Takehito Yokoi · Hiroyuki Hirasawa

Department of Emergency and Critical Care Medicine, Chiba University Graduate School of Medicine, Chiba, Japan

n= 90

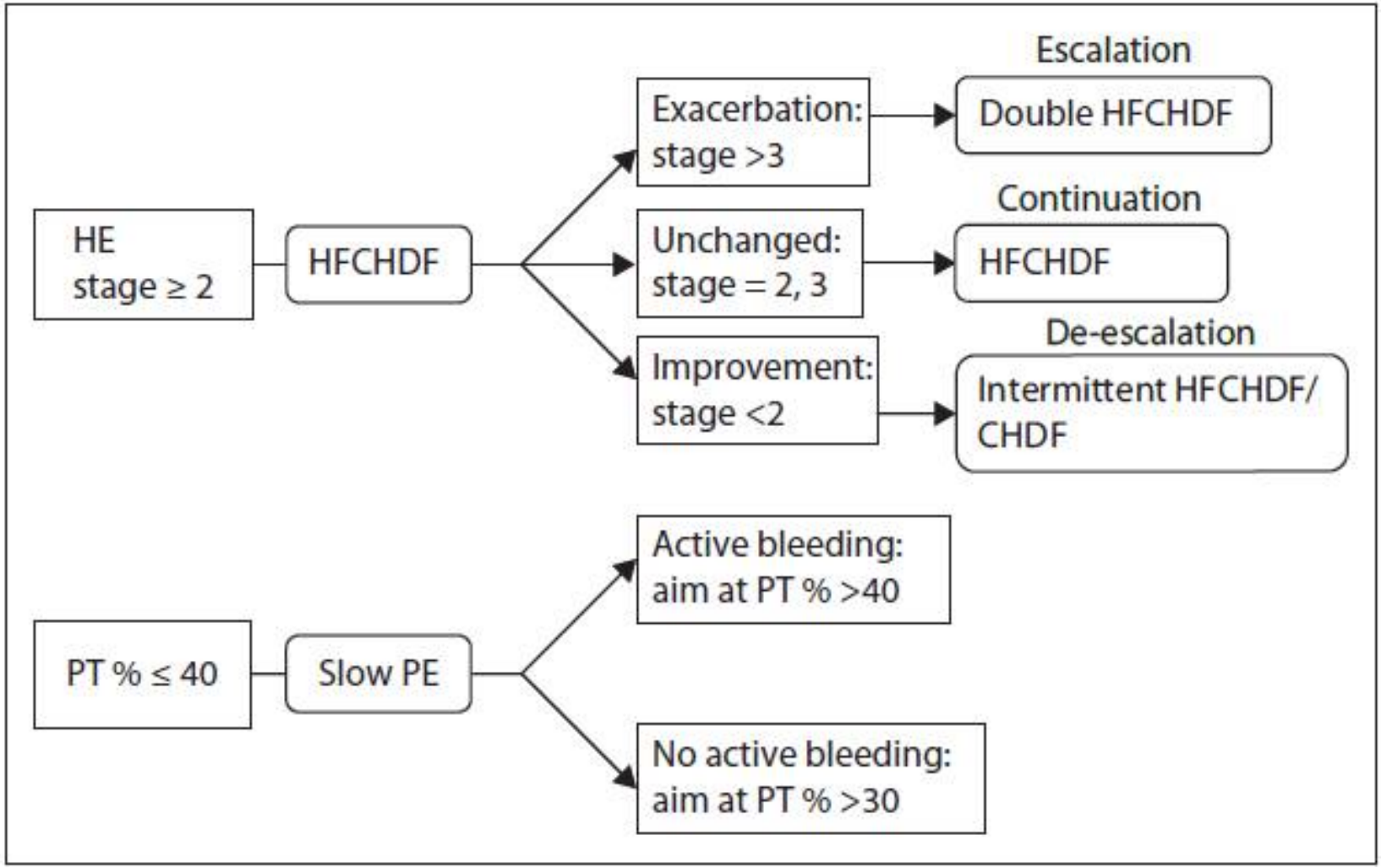




Blood flow rate	200–250	ml/min
Plasma removal rate	8–12	ml/min
FFP infusion rate	8–12	ml/min
⇒ Dialysate flow rate	300–500	ml/min
Ultrafiltration rate	5–10	ml/min

SPE: 6-8 hours / 1PE

The compensatory functions and other roles of BP involve: (1) removal of materials such as those causing HE; (2) replacement of substances such as clotting factors; (3) correction of water, electrolyte, and acid-base balance in patients with acute renal failure [10], a common complication of FHF, and (4) removal of various pro-inflammatory cytokines believed to elevate intracranial pressure and participate in the mechanism of onset of HE



Ανάκτηση συνείδησης: 70%!!!

Nephrol Dial Transplant (2011) 26: 3633–3639
doi: 10.1093/ndt/gfr115
Advance Access publication 18 March 2011

Comparison of Molecular Adsorbents Recirculating System (MARS) dialysis with combined plasma exchange and haemodialysis in children with acute liver failure

Betti Schaefer, Franz Schaefer, Guido Engelmann, Jochen Meyburg, Karl Heinz Heckert, Markus Zorn and Claus Peter Schmitt

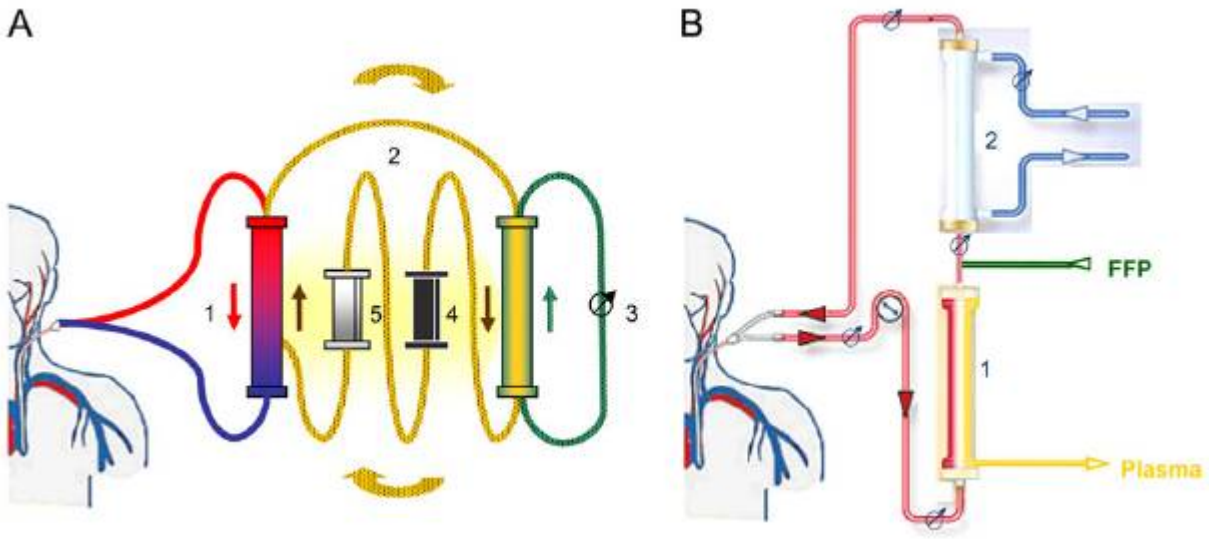
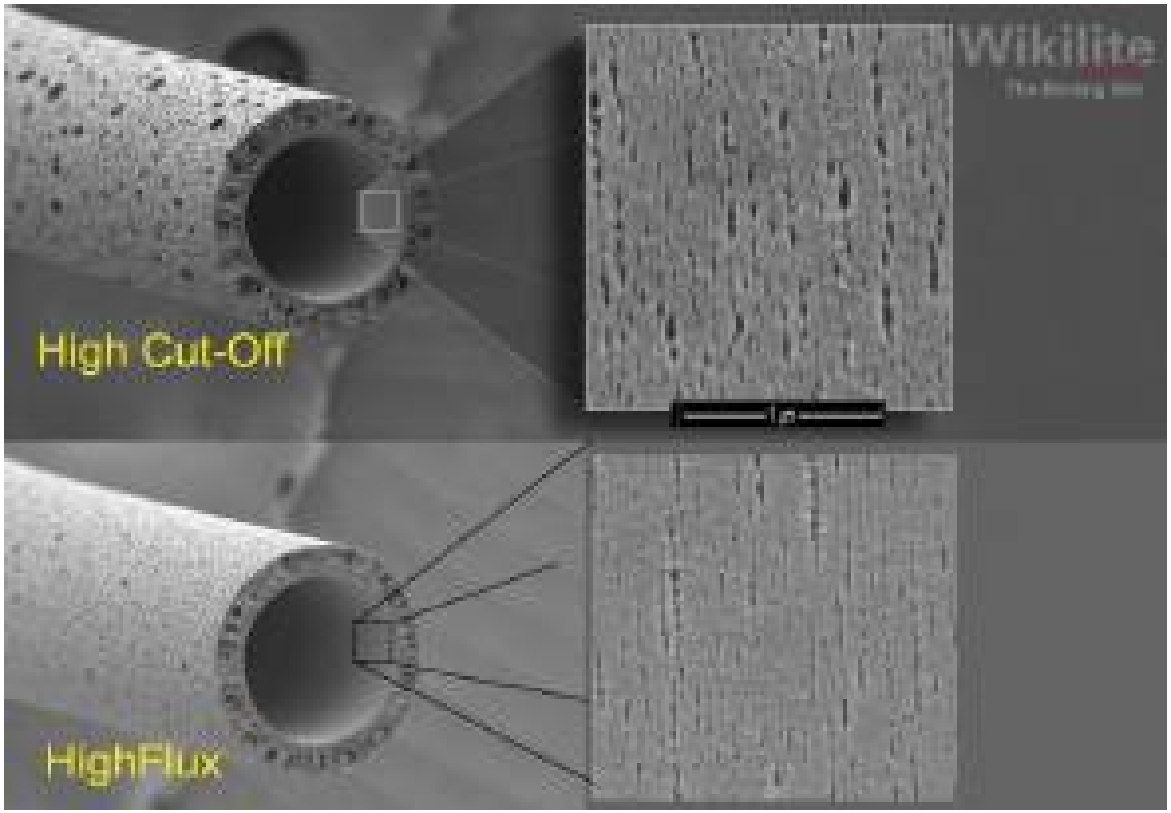


Table 3. Intraindividual comparison of serum bilirubin, plasma ammonium and INR changes in five children treated with both the adult MARS system and PE/HD, respectively

	MARS adult system			PE/HD		
	Pretreatment	Posttreatment	% Change	Pretreatment	Posttreatment	% Change
Total bilirubin (mg/dL)	17.5 ± 3.9	16.8 ± 4.7	−3.3 ± 22.9	21.6 ± 11.6	13.9 ± 9.7*	−36.8 ± 14.3#
Unconjugated bilirubin (mg/dL)	9.1 ± 1	9.6 ± 1.8	5.2 ± 10.5	10.8 ± 5.6	7.2 ± 4.7	--33.9 ± 18.9#
Ammonia (μmol/L)	140 ± 51	115 ± 74	−19 ± 30	141 ± 61	73 ± 47*	−48 ± 20#
INR	1.7 ± 0.3	2.3 ± 1.2	32 ± 53	2.4 ± 1.1	1.3 ± 0	−35 ± 28#

High cut-off Hemodialysis



45 KD

20 KD

Study	EuLITE*	MYRE
Patient number	90	98
Study population	Newly diagnosed myeloma Biopsy confirmed Light chains >500 mg/L Requires acute dialysis	New or untreated myeloma Biopsy confirmed Requires acute dialysis
Chemotherapy regimen	Bortezomib Doxorubicin Dexamethasone	Bortezomib Dexamethasone Cyclophosphamide (if no response after third cycle)
HF-HD protocol	Minimum 4-hour treatments thrice weekly Nephrologists' discretion	5-hour treatments 8 sessions over first 10 days 3 sessions per week thereafter
HCO-HD protocol	Two 1.1 m^2 filters in series 6 hours day 0 8 hours days 2, 3, 5-7, 9, 10 8 hours QOD after day 12	Single 2.1 m^2 filter 5-hour treatments 8 sessions over first 10 days 3 sessions per week thereafter
Primary outcome	Dialysis independence day 30 51.5% HF-HD vs. 55.8% HCO-HD p = NS	Dialysis independence day 30 33% HF-HD vs. 41% HCO-HD p = NS
Secondary outcome	Overall renal recovery 66% HF-HD vs. 58.1% HCO-HD p = NS	Dialysis independence 6 months 35% HF-HD vs. 57% HCO-HD p = 0.04 **

HCO-HD = high cut off hemodialysis; HF-HD = high flux hemodialysis; NS = not significant; QOD = every other day.

* Αυξημένη συχνότητα λοιμώξεων του αναπνευστικού

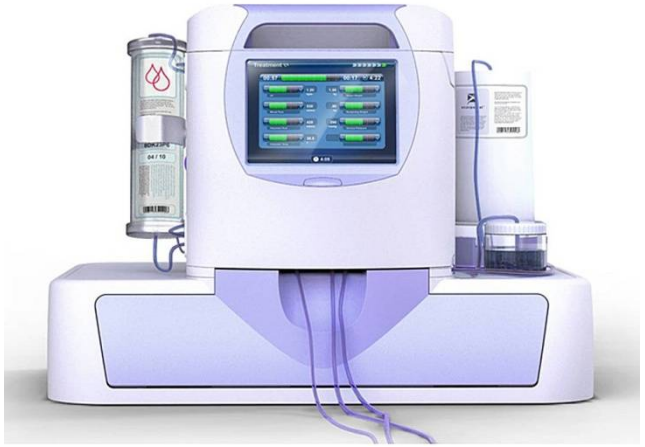
**** Γενικά με το Bortezomib και χωρίς HCOHD ανάκαμψη της νεφρικής λειτουργίας στο 55%**

Finkel, J Onco-Nephrol 2017

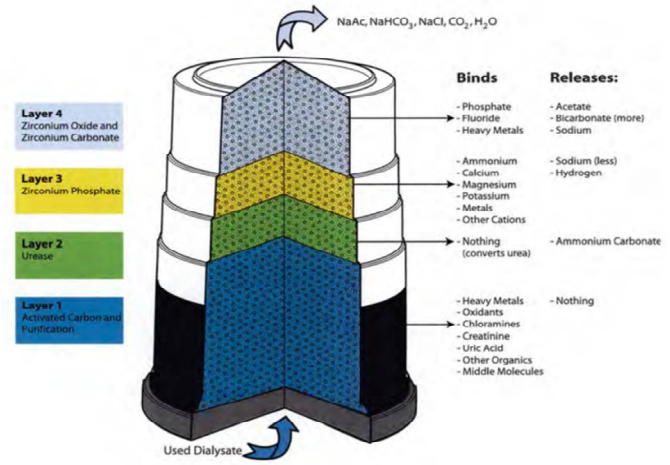
Προσροφητικές ουσίες

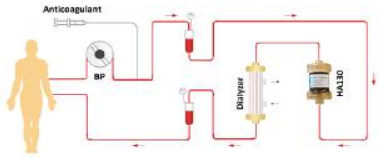
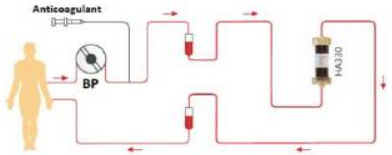
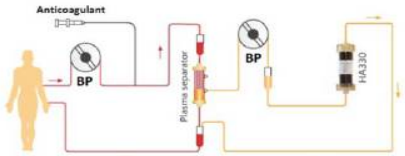
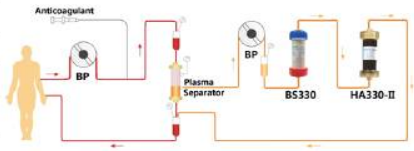
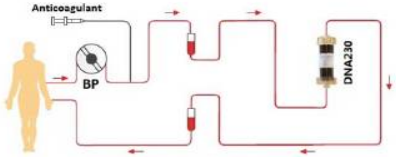
REDY machine (1973)

Allient system
FDA-approved



XCR-6



Product Image	Clinical Options	Diseases		Treatment Models
	HA130	Uremic Complications	Skin Itching Cardiovascular Disease Refractory Hypertension Renal Osteodystrophy Malnutrition Inflammatory Response	 HA130 Adsorption Column for Combined Artificial Kidney Methods: Whole Blood Adsorption
	HA230	Drug Intoxication	Barbitals Sedative-Hypnotics Antidepressants Antibiotics Other Drugs	 HA330/HA330-II/HA280/HA230 Adsorption Column Method: Whole Blood Adsorption
		Acute Poisoning	Pesticides Biotoxin Phytotoxin Industrial Poisoning	
	HA330	Critical Care	Sepsis, Septic Shock Acute Pancreatitis Serious Burn Severe Trauma Severe Infection ARDS	 HA330/HA330-II/HA280/HA230 Adsorption Column Method: Plasma Adsorption
	BS330	Liver Diseases	Hyperbilirubinemia Hyperbileacidemia	 DPMAS - Double Plasma Molecular Adsorption System Method: Plasma Adsorption
	HA330-II	Liver Diseases	Hepatic Encephalopathy Drug-induced Liver Damage Hyperbilirubinemia	
	DPMAS - BS330 + HA330-II	Liver Diseases	Hepatitis Liver Failure	
	HA280	Auto-Immune Diseases	Rheumatoid Arthritis Sensitive Purpura Psoriasis Pemphigus Severe Drug Eruption	 DNA230 Adsorption Column
	DNA230	Auto-Immune Diseases	Systemic Lupus Erythematosus (SLE)	
	DNA230 + HA280	Auto-Immune Diseases	butterfly erythema drug-induced lupus lupus nephritis	

(1) The adsorption columns have wide clinical applications, including but not limited to the above diseases.

(2) Per clinical diagnosis, all adsorption columns can be combined with other Blood Purification methods like HD, HF or CRRT etc. for better therapeutic effect if the patient has multiple organs failure like kidney damage etc.

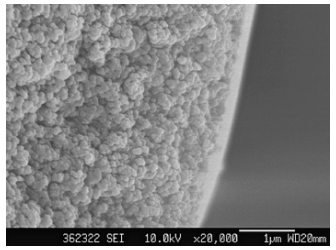
Int J Artif Organs 2011; 34 (4): 339-347 DOI: 10.5301/IJAO.2011.7748

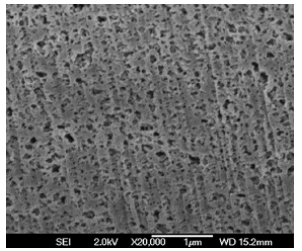
ORIGINAL ARTICLE

Combination of maintenance hemodialysis with hemoperfusion: A safe and effective model of artificial kidney

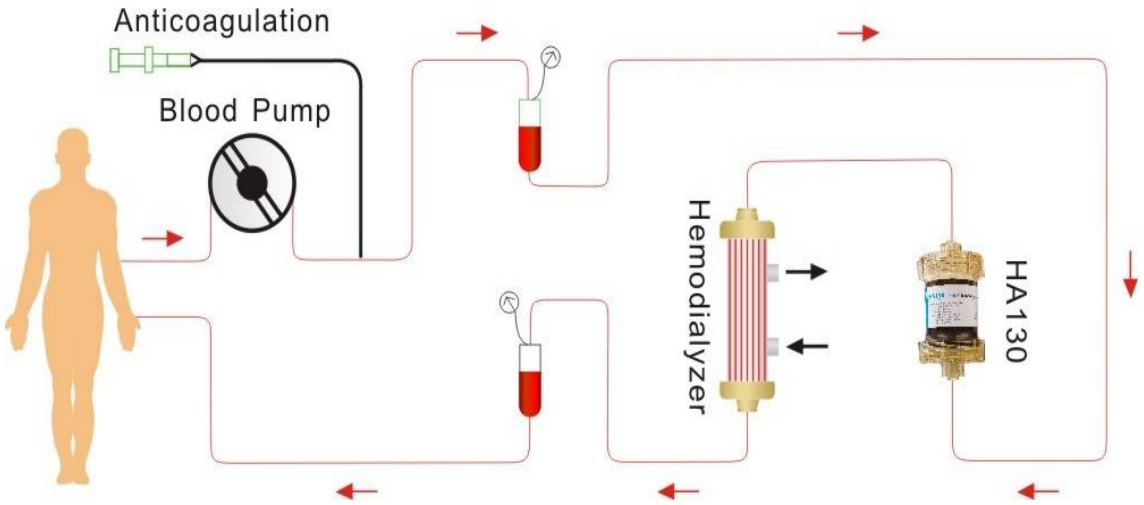
Shun-Jie Chen, Geng-Ru Jiang, Jian-Ping Shan, Wei Lu, Hai-Dong Huang, Gang Ji, Ping Wu, Gu-Feng Wu, Wei Wang, Chun Zhu, Fan Bian

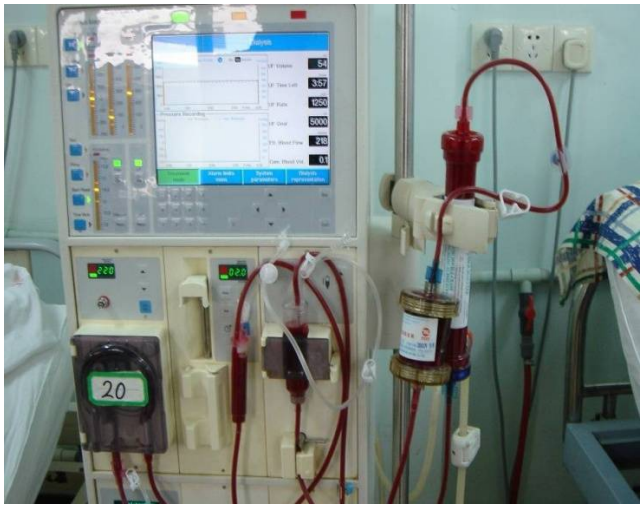
Department of Nephrology, Xinhua Hospital Affiliated to Shanghai Jiaotong University School of Medicine, Shanghai - China





Blood Purif 2018; 46:187





1 HP / wk

Baseline clinical characteristics	Group 1 (n=51)	Group 2 (n=49)	P
Male/female	28/23	26/23	1.000[b]
Age (years	53.54±13.82	51.4±12.52	0.4196[a]
Diseases caused by renal failure (%)			
cGN	20(39.22%)	22(44.90%)	0.6857[b]
DM	14(27.45%)	13(26.53%)	1.000[b]
HBP	9(17.65%)	8(16.33%)	1.000[b]
ADPKD	3(5.88%)	4(8.16%)	0.7124[b]
Unknown	5(9.80%)	2(4.08%)	0.4367[b]
Vascular access for dialysis (%)			
Arteriovenous fistula	51(100%)	49(100%)	-
BMI (kg/m^2)	23.1 ± 1.4	22.8 ± 3.6	0.5813[a]
Complications (%)			
CAD	5(9.80%)	4(8.16%)	1.0000[b]
Congestive heart failure	8(15.69%)	10(20.41%)	0.6083[b]
Peripheral vascular disease	3(5.88%)	5(10.20%)	0.4829[b]
Stroke	1(1.96%)	2(4.08%)	0.6136[b]
COPD	2 (3.92%)	3 (6.12%)	0.6747[b]
Dialysis age months	21.0±11.8	25.8±13.5	0.0617[a]
SBP (mmHg)	153.6± 45.7	155.1± 49.2	0.8747[a]
DBP(mmHg)	89.7± 27.1	87.1± 29.1	0.6447[a]
Laboratory data			
Albumin (g/dL)	3.5±0.5	3.4±0.6	0.3667[a]
Ca^{2+} (mg/dL)	8.3±0.8	8.4±0.9	0.5580[a]
P^{3+} (mg/dL)	4.7±1.6	4.8±1.5	0.7480[a]
iPTH (pg/dL)	254.56±158.07	279.23±165.36	0.4474[a]
Hb (g/L)	82.3 ± 16.2	85.2 ± 19.8	0.4239[a]
spKt/V	1.43±0.19	1.46±0.18	0.4200[a]

Variable	Group 1 n=51)	Group 1 n=41)	Group 2 (n=49)	†P 0years	Group 2 (n=30)	§P
	0 years	2 years	0 years		2 years	2 years
SBP (mmHg)	153.6± 45.7	136.2± 28.6	155.1± 49.2	0.8747	159.5± 60.8	0.0348
DBP (mmHg)	89.7± 27.1	71.4± 15.6	87.1± 29.1	0.6447	90.6± 32.4	0.0015
HR (time/min)	76.8± 18.9	71.1± 9.8	74.9± 21.3	0.6378	79.1± 19.8	0.0281
Cardiothoracic ratio	0.46± 0.042	0.42± 0.028	0.45± 0.058	0.3244	0.48± 0.052	<.0001
EF (%)	64.7 ± 9.1	72.4 ± 6.8	66.1 ± 7.3	0.3993	62.5 ± 10.5	<.0001
CO (L/min)	5.89 ± 1.20	5.81 ± 0.96	5.77 ± 1.33	0.6365	5.83 ± 1.55	0.9468
E/A	0.92 ± 0.32	0.88 ± 0.29	0.83 ± 0.17	0.0839	0.85 ± 0.20	0.6273
LVMI (g/m^2)	102.99 ± 12.39	101.38 ± 14.95	105.99 ± 13.48	0.2491	175.61 ± 51.88	<.0001
Hb (g/L)	82.3 ± 16.2	105.7 ± 17.7	85.2 ± 19.8	0.4239	83.9 ± 14.4	<.0001
EPO (U/weekly)	3861.35±123.41	3232.91±109.15	3916.67±163.57	0.585	4729.66±208.12	<.0001
SI (µmol/L)	12.4±4.41	12.5±5.07	12.5±4.89	0.9146	12.6±5.44	0.9368
TIBC (µmol/L)	50.97±13.00	51.08±13.73	50.83±7.41	0.9477	52.11±15.61	0.7691
Alb (g/dL)	3.5 ± 0.5	3.6 ± 0.7	3.4 ± 0.6	0.1214	3.5 ± 0.8	0.0869
BMI (kg/m^2)	23.1 ± 1.4	25.6 ± 6.9	22.8 ± 3.6	0.5813	21.5 ± 5.5	0.009
Types of antihypertensive drugs	2.6± 0.5	1.3± 0.4	2.4± 0.9	0.1705	2.7± 0.6	<.0001
spKt/V	1.43±0.19	1.41±0.22	1.46±0.18	0.42	1.43±0.31	0.7513

SBP = systolic blood pressure; DBP = diastolic blood pressure; HR = heart rate; EF = ejection fraction; CO = cardiac output; E/A = early/atrial mitral inflow velocities; LVMI = left ventricular mass index; Hb = hemoglobin; SI = serum iron; TIBC = total iron binding capacity; Alb = serum albumin; BMI = body mass index; †*P*: Group 1 vs. Group 2 (T=0 years) ; §*P*: Group 1 vs. Group 2 (T=2 years).

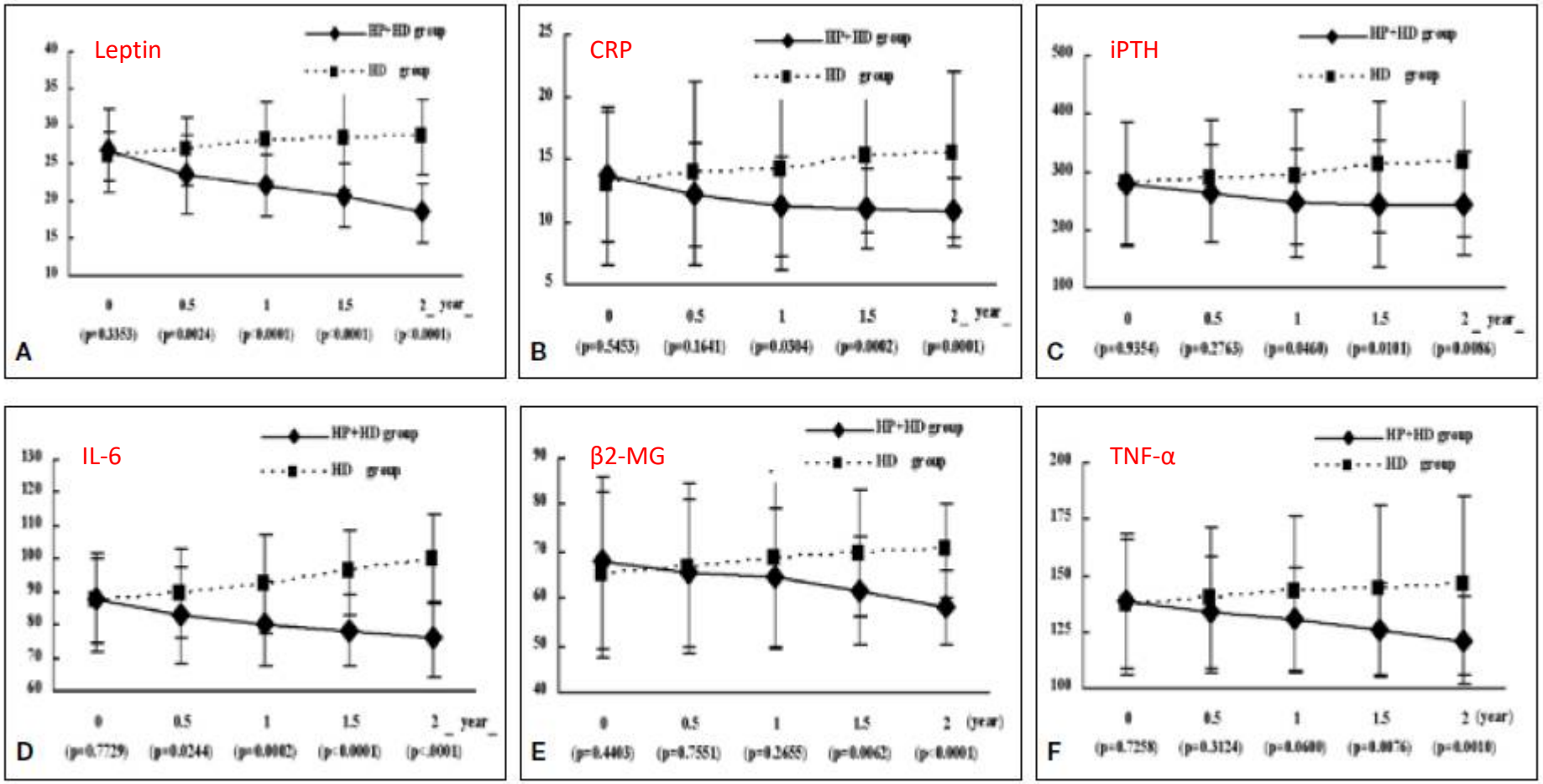

Leptin
HP+HD group
HD group
A
CRP
B
iPTH
C
IL-6
D
β2-MG
E
TNF-α
F

TABLE III - SF-36 SCORES OF GROUP 1 VERSUS GROUP 2 AFTER TWO YEARS

Dimension	Group 1 n=41 2 years	Group 2 n=30 2 years	P
PF	58.48±20.05	57.32±19.45	0.8028
RF	38.64±21.84	36.56±19.43	0.6703
BP	64.62±27.54	44.31±21.45	0.0009
GH	48.48±18.29	40.43±10.78	0.0415
VT	56.82±21.59	49.36±20.11	0.0321
SF	58.69±15.74	55.35±12.57	0.0641
RE	56.88±15.19	51.16±12.22	0.0257
MH	65.09±20.24	55.23±21.47	0.0463
Total score	59.76±19.46	41.09±15.52	0.0069

PF = physical functioning; RP = role-physical; BP = bodily pain; GH = general health; VT= vitality; SF = social functioning; RE = role-emotional; MH = mental health.

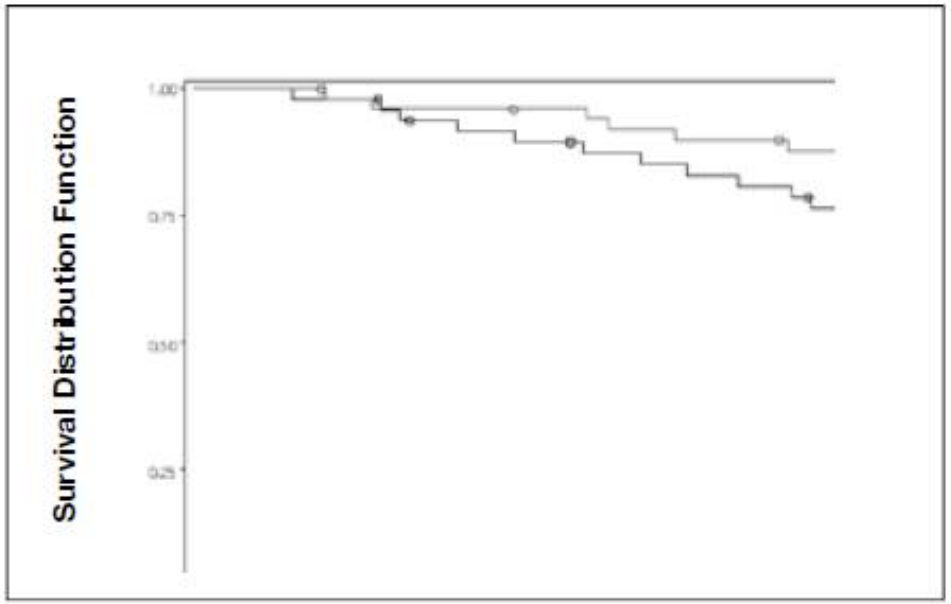


Fig. 3 - *Survival curve of the two groups of patients during the study period; log-rank test results indicated p<0.01.*

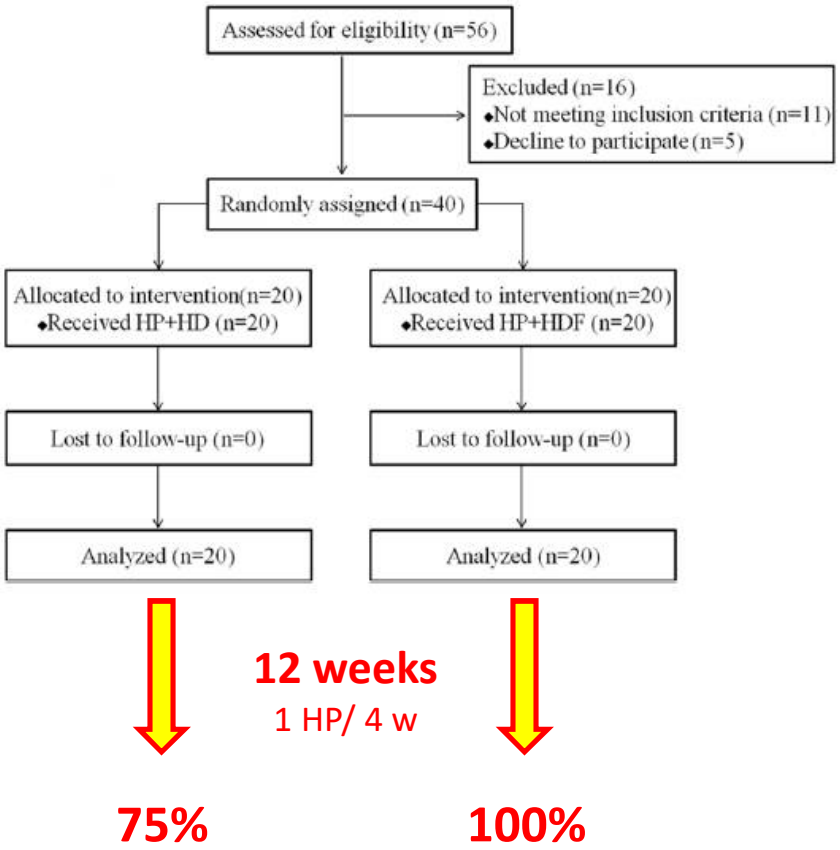
- **6 θάνατοι στην HP + HD (12.77%)**
- **14 θάνατοι στην HD (31.82%)**

Int J Clin Exp Med 2016;9(5):8563-8568
www.ijcem.com /ISSN:1940-5901/IJCEM0019834

Original Article

Comparison of combined blood purification techniques in treatment of dialysis patients with uraemic pruritus

Jing Zhang[1*], Yanggang Yuan[1*], Xiaofei An[2], Chun Ouyang[1], Haibin Ren[1], Guang Yang[1], Xiangbao Yu[1], Xiaolin Lv[1], Bo Zhang[1], Ningning Wang[1], Huijuan Mao[1], Yamei Zhu[1], Changying Xing[1]



J Int Transl Med, 2015, 3(3): 180-184; doi:10.11910/2227-6394.2015.03.03.05

Research Article Open Access

Effect of Hematodialysis plus Hemoperfusion on Insulin Resistance and Nutritional Status of Patients with End-Stage Diabetic Nephropathy

Antony Raine, Daniel Cordonnier*, Eberhard Ritz

Section of Nephrology, The University of Texas MD Anderson Cancer Center, Houston, Texas, USA

Table 2 Changes of Inflammatory Factors in Three Groups Before and After treatment ($\bar{x} \pm s$, ng/L)

Groups	Time	CRP	TNF-α	IL-6
Group A (n=28) 3 HD/ wk	Before treatment	15.71±4.48**	829.02±89.52**	155.94±36.48**
	12 weeks after treatment	15.49±4.67**	803.17±96.94**	146.31±37.23**
Group B (n=30) 2 HD + 1 HDF/ wk	Before treatment	15.47±3.18**	842.19±77.68**	161.02±34.70**
	12 weeks after treatment	13.03±4.19**▪△	754.28±82.53**▪△	127.89±31.34**▪▪△
Group C (n=28) 2 HD + 1 HP-HD/ wk	Before treatment	15.42±4.03**	828.14±83.87**	153.47±35.66**
	12 weeks after treatment	10.86±3.96**▪▪△△▲	687.56±87.42**▪▪△△▲▲	109.38±35.34**▪▪△△▲
Control group (n=24)	-	3.69±1.68	55.12±30.27	41.67±16.82

Compared with control group, **P<0.01; Compared with treatment before, ▪P<0.05, ▪▪P<0.01; Compared with group A, △P<0.05, △△P<0.01; Compared with group B, ▲P<0.05, ▲▲P<0.01

Table 3 Comparison of Relevant Biochemical Indexes in Three Groups Before and After Treatment ($\bar{x} \pm s$)

Groups	Time	BUN (mmol/L)	Scr (μmol/L)	FBG (mmol/L)	FINS (μIU/mL)	Homa-IR
Group A (n=28)	Before treatment	22.08±6.21	837.20±214.60	10.52±2.69	11.29±6.20	6.40±1.91
	12 weeks after treatment	23.47±6.28	765.70±233.20	10.37±2.75	11.17±6.77	5.65±1.70
Group B (n=30)	Before treatment	23.32±6.67	849.60±243.20	10.48±3.09	11.59±6.98	6.22±1.31
	12 weeks after treatment	20.86±5.92	813.40±245.80	10.26±2.91	10.51±4.82	5.48±1.57
Group C (n=28)	Before treatment	23.57±6.60	839.50±233.30	10.56±2.61	11.43±4.94	6.43±1.71
	12 weeks after treatment	22.71±6.72	878.10±266.40	8.75±2.47*△	7.93±4.86*△	4.42±1.60*△

Compared with treatment before, *P<0.05, **P<0.01; Compared with group A, ▪P<0.05; Compared with group B, △P<0.05 .

Table 4 Change of Nutritional Status in Three Groups Before and After Treatment ($\bar{x} \pm s$)

Groups	Time	Hb (g/L)	Alb (g/L)	BMI (kg/m²)
Group A (n=28)	Before treatment	104.06±13.45	32.18±2.69	21.62±1.83
	12 weeks after treatment	104.82±12.36	33.02±3.81	22.60±2.58
Group B (n=30)	Before treatment	104.23±13.17	32.64±4.27	22.02±2.47
	12 weeks after treatment	104.98±13.79	33.57±3.79	22.73±1.69
Group C (n=28)	Before treatment	103.98±12.76	32.75±4.38	21.98±2.28
	12 weeks after treatment	113.31±12.94*▪△	35.73±3.71*▪▪△	24.30±1.51*▪▪△△

Compared with treatment before, **P<0.01; Compared with group A, ▪P<0.05, ▪▪P<0.01; Compared with group B, △P<0.05, △△P<0.01.

Intensive Treatment Solution:

Recommended for: Patients with longer dialysis years, and with complications, such as renal osteopathy, poor nutrition, skin itching, peripheral neuropathy, etc.)
Recommended treatment: 4 times/month, change to maintenance treatment after conditions have been controlled.

Maintenance Treatment Solution:

Recommended for: Patients with shorter dialysis years, for Preventive treatment of patients without dialysis complications; Or for patient's maintenance treatment after intensive treatment has been controlled.
Recommended treatment: 1 to 2 times/month.

Individualized Treatment Solution:

Refractory hypertension: (HP + HD) 1 time /week, lasting for 8 weeks [1]
Refractory skin itching: (HP + HD) 3 times/week, lasting for 2 weeks [2]
CKD-MBD, renal anemia, malnutrition: (HP + HD) 1 time/week, lasting for 12 weeks [3-5]

Reference:
[1] Xu Yuxiang, Zhou Qing overflow, Sun Jujun, etc., resin adsorption on maintenance hemodialysis patients with refractory hypertension renin - angiotensin aldosterone system [J]. The effect of blood purification in **China**, 2013 (6) : 316-319.
[2] Mr Chirac, Zhou Rong Chen Mindong, Shen Jie. Short-term high frequency blood perfusion combined hemodialysis on regular hemodialysis patients curative effect observation of itchy skin [J]. Journal of blood purification in **China**, 2015, 14 (2) : 97-99.
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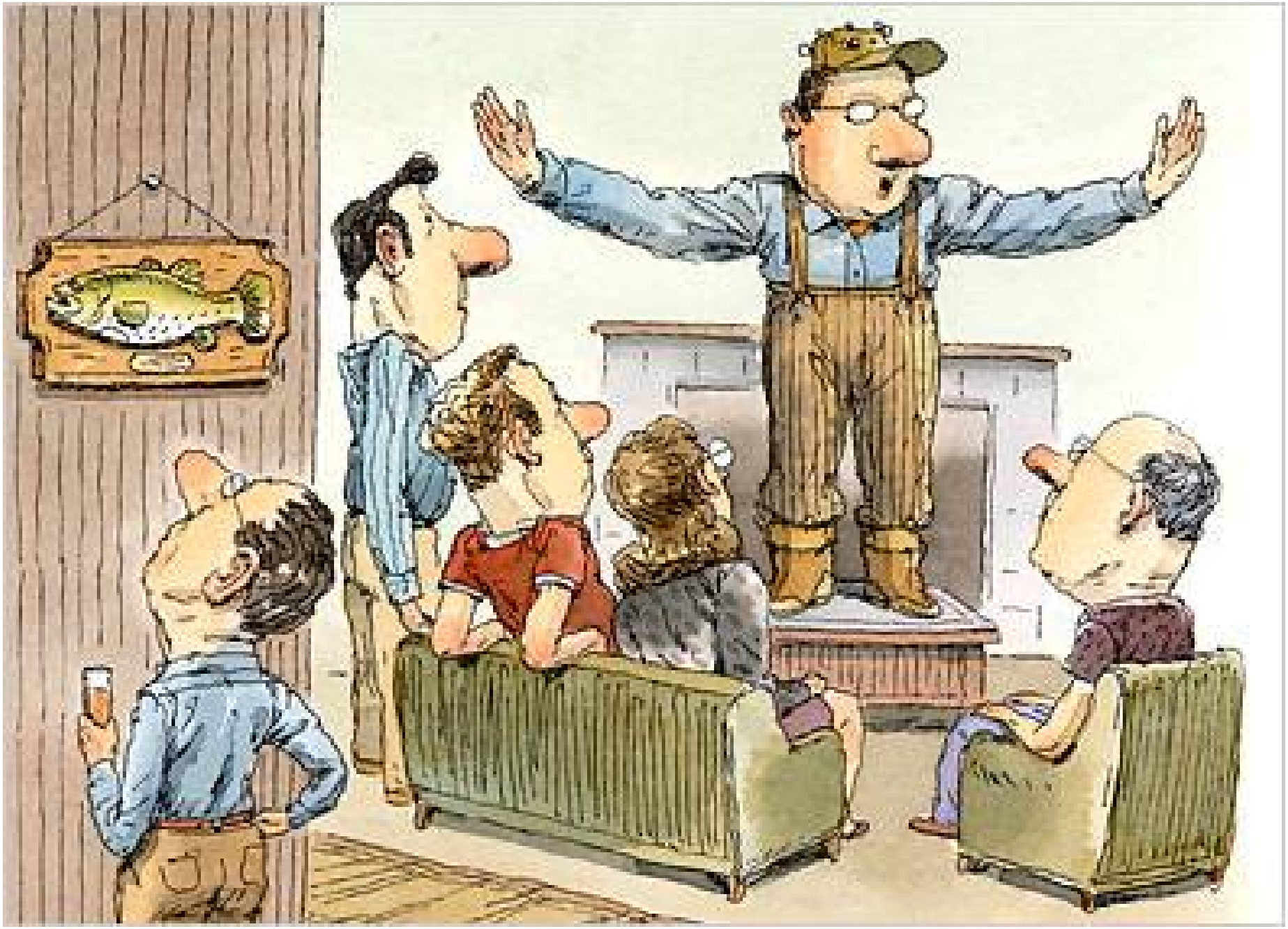
[4] Xu Peng, Chen weidong. Different blood purification methods on the effect of erythropoietin maintenance hemodialysis patients [J]. Journal of blood purification in **China**, 2014, 13 (6) : 437-440.
[5] Xu Yanmei Xu Chuanwen. Blood perfusion combined hemodialysis in maintenance hemodialysis patients micro inflammation in the body and the influence of malnutrition state [J]. Journal of **Chinese** integrative medicine emergency, 2014, 21 (1) : 42 to 45.

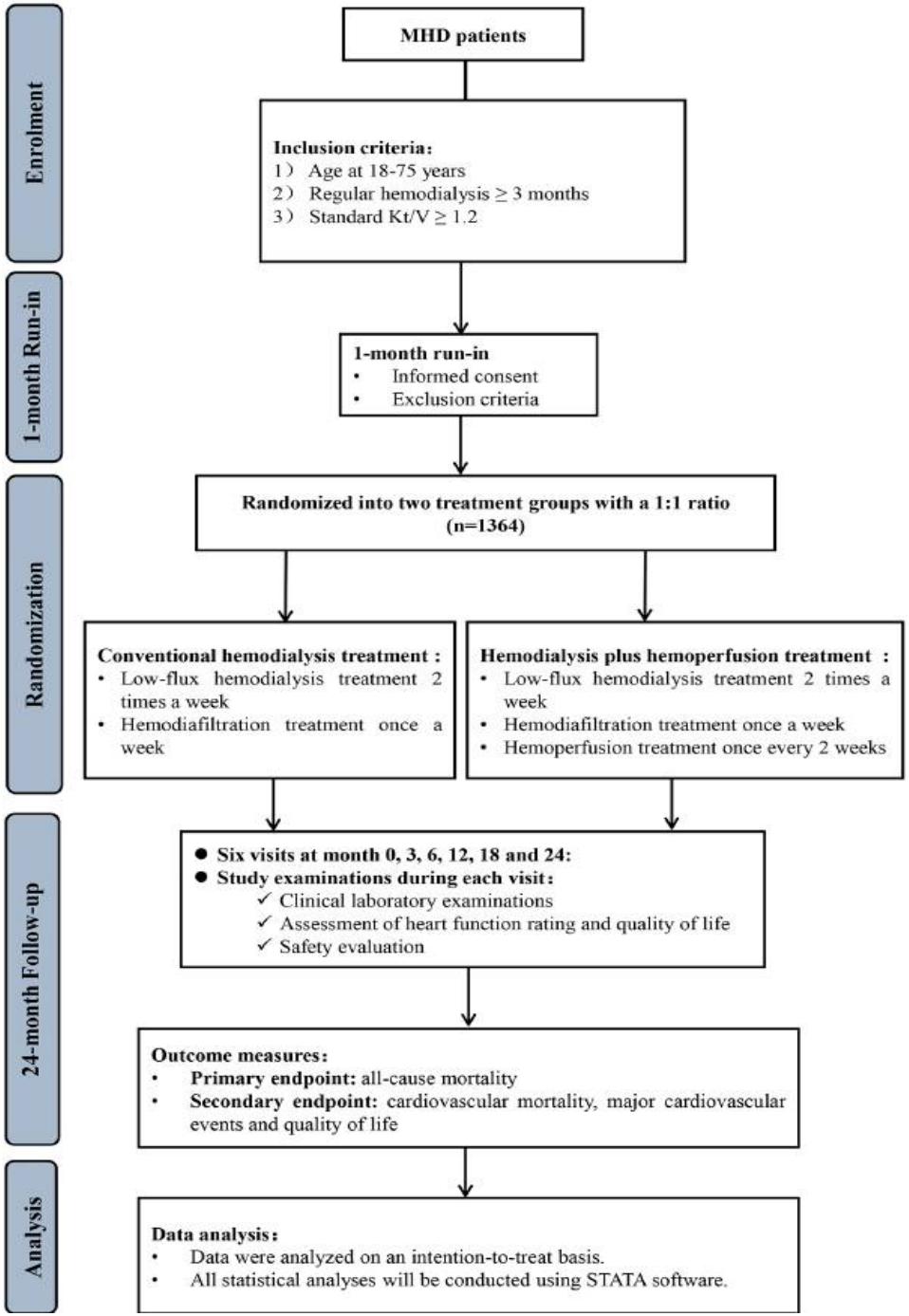


John Cuneo

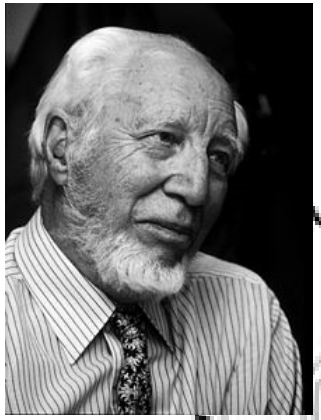
BMJ Open

Randomised, open-label, multicentre trial comparing haemodialysis plus haemoperfusion versus haemodialysis alone in adult patients with end-stage renal disease (HD/HP vs HD): study protocol

Wei Lu, Geng-Ru Jiang, The HD/HP versus HD trial Group



- Αιμοκάθαρση με πλασμαφαίρεση
- Αιμοκάθαρση με ανοσοπροσρόφηση σε μετ/ση νεφρού
- Αιμοκάθαρση με αφαίρεση σε ηπατική ανεπάρκεια
- Αιμοκάθαρση με HCO φίλτρα σε ΠΜ με ΟΝΑ
- Αιμοκάθαρση με αιμοπροσρόφηση σε ΧΝΑ

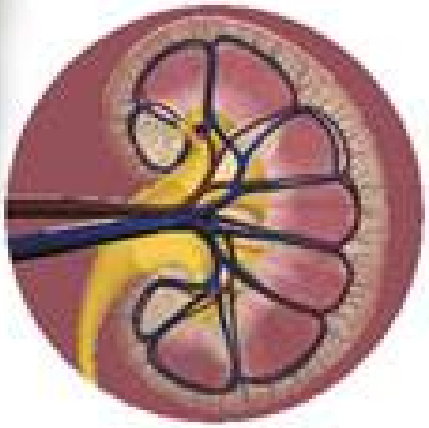


100 jaar Rijksoctrooiwet

Kunstnier (1943)

Willem Kolff

44 eurocent



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