

Actualización en terapias de soporte renal en el paciente crítico

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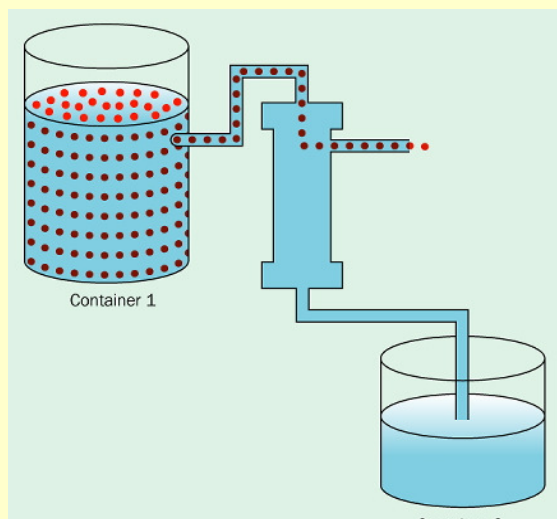
Cinética de la urea

$$URR = \frac{U_{pre} - U_{post}}{U_{pre}} \times 100\%$$

$$\frac{K \cdot t}{V} = -\ln(1 - URR)$$

$$\frac{K \cdot t}{V} = -\ln((1 - URR) - 0.03) + (4 - 3.5(1 - URR)) \cdot \frac{UF}{W}$$

CONCEPTO KT/V



K= clearance filtro

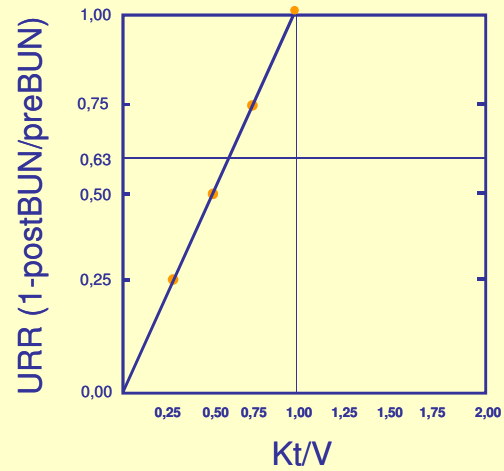
T= tiempo (min)

V=Vol distribución

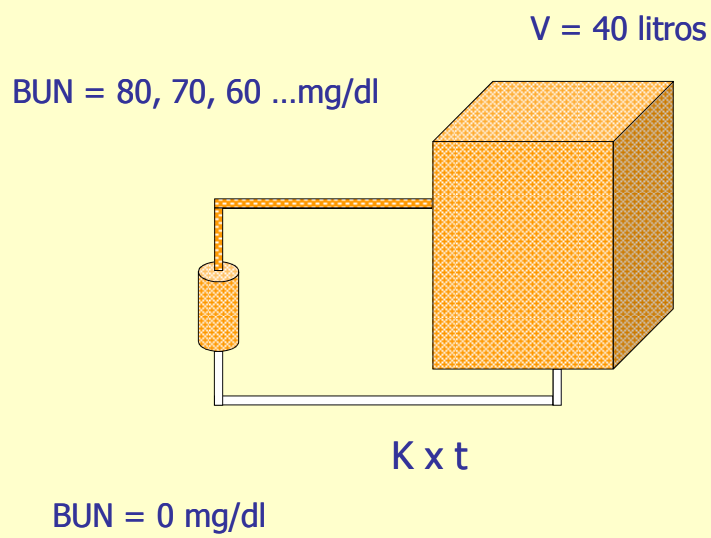
Urea (ml)

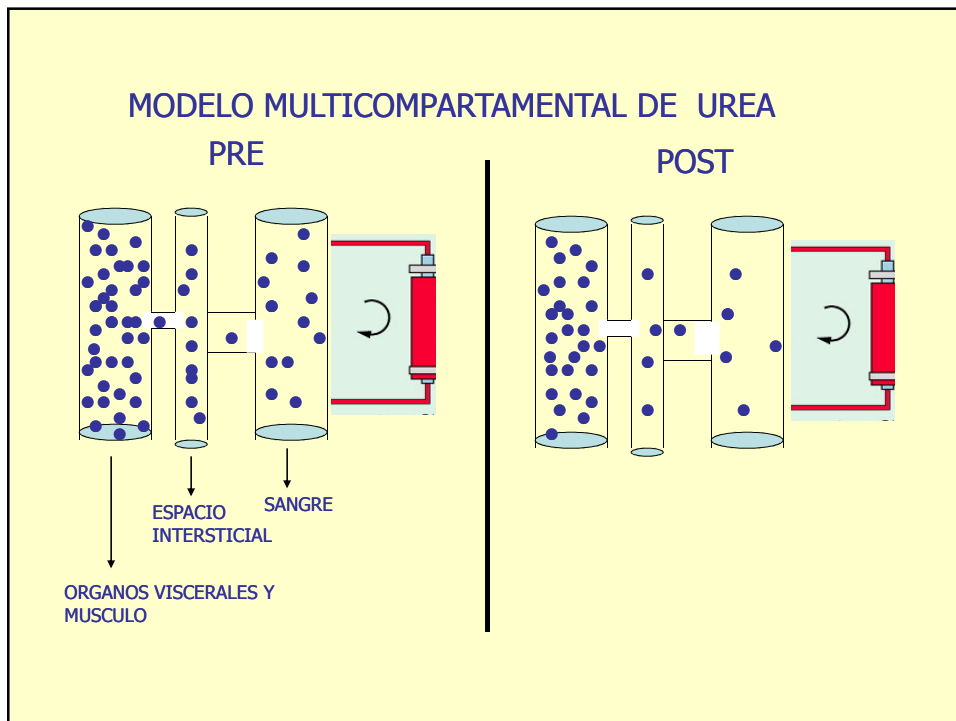
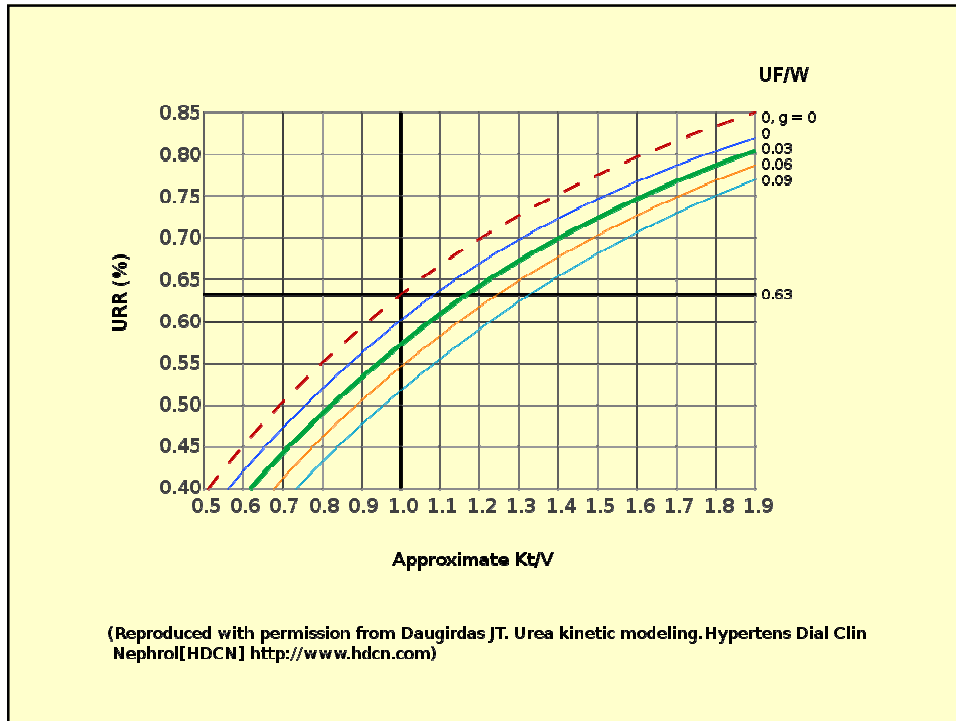
$$\frac{K \text{ (ml/min)} * T \text{ (min)}}{V \text{ (ml)}}$$

V (ml)

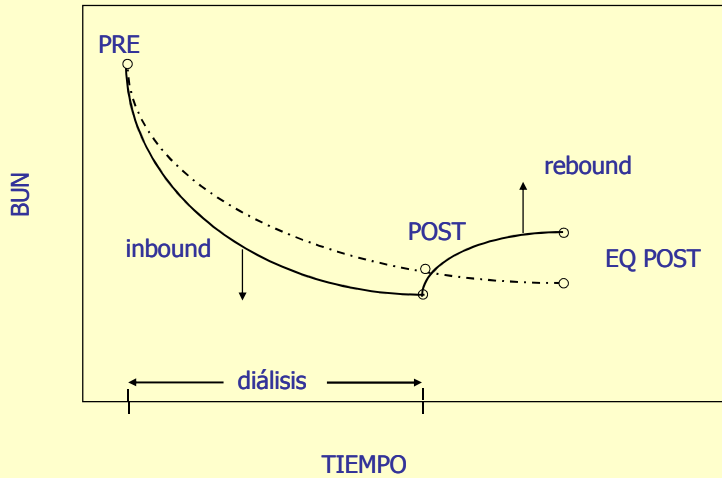


Módulo de cinética de la urea





Efecto del secuestro de urea en la caída del BUN intradiálisis (inbound) y del ascenso post-diálisis (rebound).

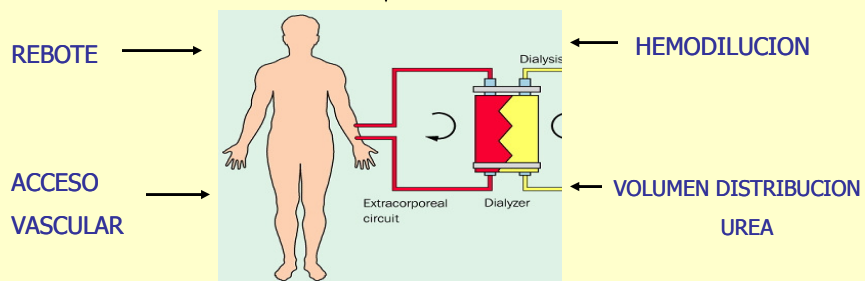


KT/V REAL EN PACIENTE CRITICO

INESTABILIDAD HEMODINAMICA – HIPOTENSION

DIFERENCIAS DE FLUJO SANGUINEO REGIONAL

MÚLTIPLES COMPARTIMENTOS



ESTRATEGIA

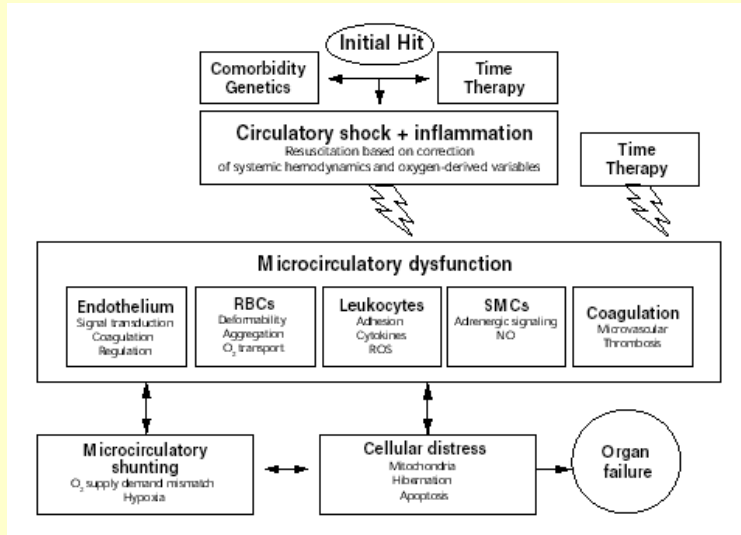
FRECUENCIA SESIONES

TIEMPO DE DIALISIS.



sepsis

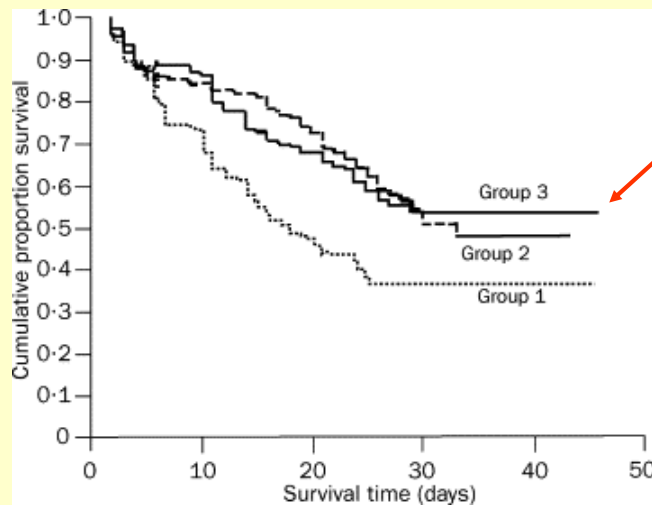
La injuria de la microcirculación es el motor de la sepsis



Síndrome de estrés microcirculatorio mitocondrial (MMDS)

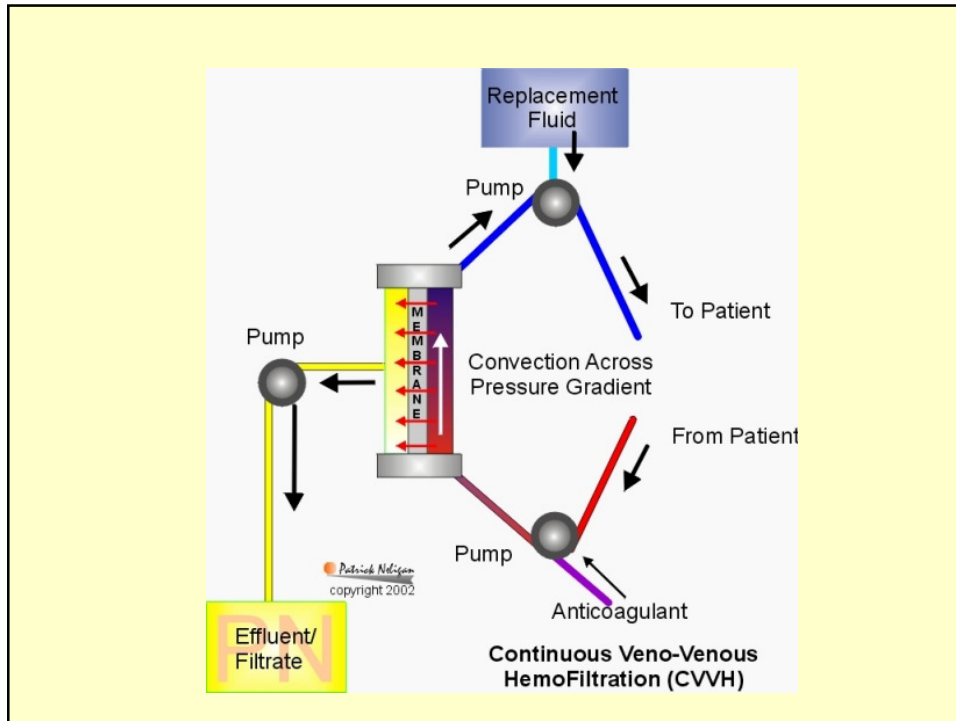
Crit Care 2005; 9(suppl 4): S13

Hemofiltración en IRA: dosis renal vs. dosis de sepsis

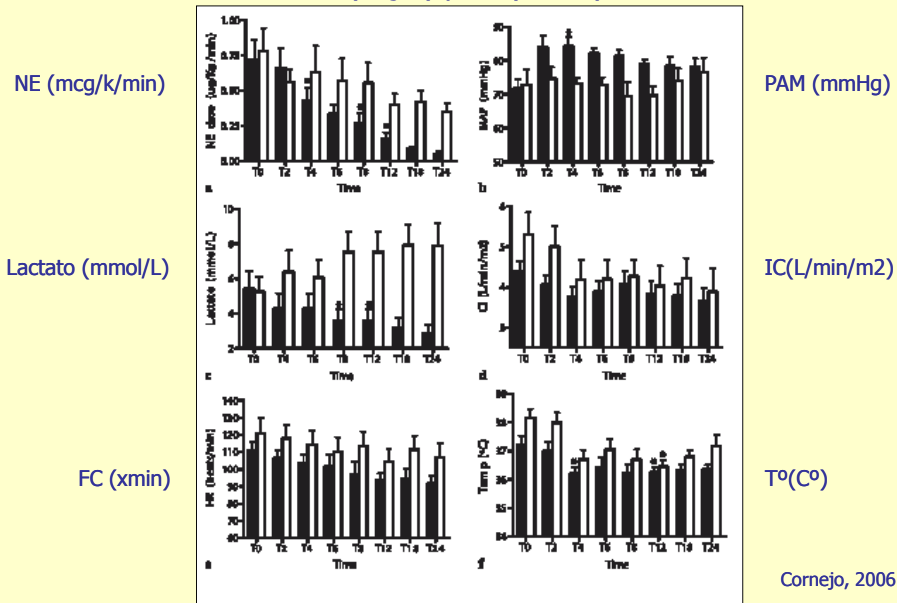


En cada grupo 11–14% de los ptes. tenían sepsis y existía una directa correlación entre dosis HF y s.v. aún sobre 35 ml/kg/h.

Ronco, Lancet 2000



Mediciones después de una sesión de 12h HFAV
R (negro) y NR (blanco).



Cual es el parámetro clave de la HFAV?

- alta tasa de ultrafiltración
- reducción de la temperatura corporal
- características de la membrana
- inicio precoz

La precocidad de inicio de la HFAV influye en la evolución

Table 1. Characteristics at baseline of 20 patients with refractory septic shock treated with short-term high-volume hemofiltration (STHVV)

No.	Age (Yrs)	Disease	Bacteria	Bilirubin (mmol/L)	APACHE II	Gender	Timing ^a (Hrs)	Weight (kg)	Dose ^b (L/kg)	Response ^c	Survival
1	73	Peritonitis (diverticulitis)	<i>E. coli</i>	93	30	F	3.25	60	0.58	Y	Y
2	70	Community-acquired pneumonia	<i>Klebsiella</i>	163	23	F	13.5	73	0.48	Y	Y
3	32	Multiple trauma + septic shock (line sepsis)	<i>Serratia</i>	143	35	M	1.5	66	0.53	Y	Y
4	35	Multiple trauma + aspiration pneumonia	<i>S. aureus</i>	111	25	M	6.75	75	0.46	Y	Y
5	32	Community-acquired pneumonia	<i>S. aureus</i>	45	37	M	2.75	65	0.53	Y	Y
6	48	Septic shock + urinary tract infection	<i>E. coli</i>	92	33	M	4	79	0.44	Y	Y
7	52	Toxic strep syndrome	<i>Streptococcus</i>	165	34	F	16.5	67	0.52	Y	N
8	66	Pneumonia + pleural abscess	<i>Pseudomonas</i>	85	31	M	12	63	0.55	Y	N
9	51	Pneumonia	<i>Legionella</i>	45	34	M	4.25	54	0.64	Y	Y
10	73	Pneumonia + meningitis	<i>Pneumococcus</i>	59	29	F	8.25	57	0.61	Y	Y
11	51	Septic shock + urinary tract infection	<i>Enterococcus</i>	68	30	F	6.5	67	0.52	Y	Y
12	69	Peritonitis + diverticulitis	<i>E. coli</i>	158	25	M	12.25	89	0.39	N	N
13	75	Peritonitis (leaking anastomosis)	<i>E. coli</i>	85	27	F	18	79	0.44	N	N
14	31	Septicemia + pneumonia	<i>Pneumococcus</i>	136	37	M	20.25	76	0.46	N	N
15	31	Septicemia + pneumonia	<i>Pneumococcus</i>	102	28	F	15	78	0.44	N	N
16	49	Septicemia + meningitis	<i>Pneumococcus</i>	49	35	M	9	81	0.43	N	N
17	71	Community-acquired pneumonia	<i>E. coli</i>	154	36	M	13.75	87	0.40	N	N
18	70	Leaking anastomosis + peritonitis	<i>E. coli</i>	89	31	M	7.25	91	0.38	N	N
19	74	Nosocomial pneumonia	<i>Pneumococcus</i>	67	28	F	17	85	0.41	N	N
20	68	Leaking anastomosis + peritonitis	<i>Enterococcus</i>	104	35	F	10.25	112	0.31	N	N

APACHE, Acute Physiology and Chronic Health Evaluation; *E. coli*, *Escherichia coli*; *S. aureus*, *Staphylococcus aureus*; F, female; M, male; Y, yes; N, no.

^aTiming is defined by the time between intensive care unit admission and the start of STHVV; ^bdose is defined as the 35-L exchanged volume indexed to body weight (L/kg of body weight); ^cresponse is defined by hemodynamic and metabolic goals attained during the 4 hrs of STHVV.

Respondedores = 7,2 ± 5 h

No-respondedores = 13,6 ± 4 h

La dosis de ultrafiltrado influye en la evolución

Table 1. Characteristics at baseline of 20 patients with refractory septic shock treated with short-term high-volume hemofiltration (STHVH)

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7	52	Toxic strep syndrome	<i>Streptococcus</i>	165	34	F	16.5	67	0.52	Y	N
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Respondedores = 0,53±0,1 (L/kg)

No- respondedores = 0,41±0

No existe diferencia en gravedad o latencia entre R vs. no-R

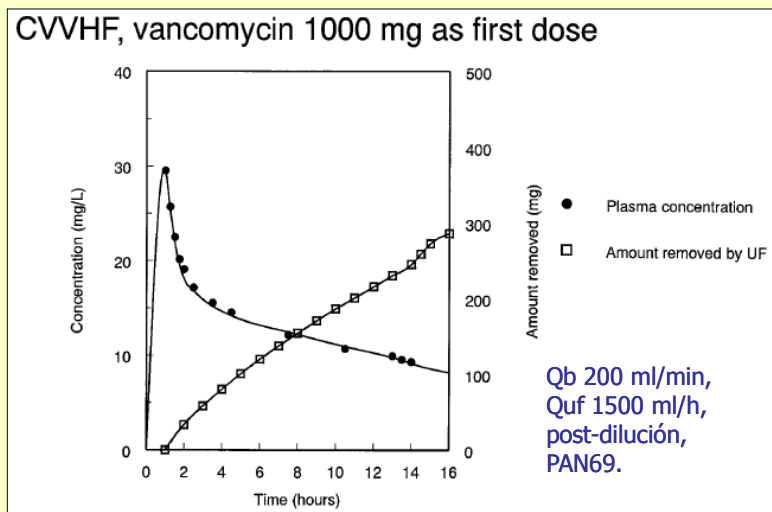
Case no.	Age (years)	Gender	Disease	Bacteria	Initial antibiotic therapy	APACHE II	SOFA	BSA (m ²)	IAP (mmHg)	HVHF ^b (h)	Delay (h)	HD (h)	Response (r)	Survival
1	31	M	Pneumonia, ARDS	<i>E. cloacae</i>	Cefotaxime + metronidazole ^a	25	14	1.83	12	4	6	0	Yes	Yes
2	68	M	ARDS, acute renal failure	<i>A. fumigatus</i>	Cefotaxime + metronidazole ^a	29	13	1.96	11	2	4	7	Yes	Yes
3	41	F	Pneumonia, ARDS, chronic myeloid leukemia	<i>S. pneumoniae</i>	Imipenem + vancomycin	27	17	1.60	17	3	6	0	No ^c	Yes
4	61	F	Urosepsis, acute renal failure, breast cancer	<i>Escherichia coli</i>	Cefotaxime	28	18	2.02	10	1	3	8	Yes	Yes
5	16	F	Pancreatitis, acute lymphoblastic leukemia	<i>Escherichia coli</i>	Imipenem + vancomycin	24	12	2.00	18	3	3	0	Yes	Yes
6 ^b	59	M	Bowel obstruction, coronary heart disease	<i>Escherichia coli</i>	Cefotaxime + metronidazole	21	10	2.01	21	3	5	0	Yes	Yes
7	61	M	Urosepsis, urethral lithiasis	<i>Escherichia coli</i>	Cefotaxime	28	12	2.17	15	1	2	0	No ^c	Yes
8	37	M	Streptococcal toxic shock, pneumonia	<i>S. group A</i>	Penicillin + clindamycin	24	11	2.04	13	1	2	4	No ^c	Yes
9	43	F	Orbital mucormycosis, Pancytopenia	<i>Zygomycetes spp</i>	Ceftazidime + amikacin ^a	24	13	1.89	9	1	5	6	Yes	Yes
10 ^b	74	F	Colonic perforation	<i>Escherichia coli</i>	Cefotaxime + metronidazole	28	6	1.97	21	1	5	7	Yes	Yes
11	77	M	Pneumonia, ARDS, retroperitoneal hematoma	<i>P. aeruginosa</i>	Cefotaxime + metronidazole ^a	30	10	2.07	16	1	2	0	Yes	Yes
12	54	M	Pneumonia, systemic candidiasis	<i>Candida albicans</i>	Cefotaxime + metronidazole	29	13	1.81	11	1	5	0	Yes	Yes
13	17	M	Febrile neutropenia, non-Hodgkin lymphoma	MRSA	Imipenem + vancomycin	29	17	1.92	16	2	4	0	No	No
14	37	F	Meningococemia, SLE	<i>N. meningitidis</i>	Ceftriaxone	28	15	1.99	16	4	6	0	No	No
15	59	F	Mesenteric ischemia, pneumonia	<i>K. pneumoniae</i>	Cefotaxime + metronidazole ^a	25	15	1.87	16	2	2	0	No	No
16 ^b	75	M	Acute cholecystitis, pancreatitis, ARDS	All cultures negatives	Cefotaxime + metronidazole	26	9	2.07	16	1	4	6	No	No
17 ^b	49	F	Bariatric surgery, urosepsis, ARDS	All cultures negatives	Piperacillin, tazobactam	26	13	1.83	14	1	5	0	No	No
18	61	M	Pneumonia, ARDS, chronic liver failure	<i>Enterococcus spp</i>	Cefotaxime + metronidazole ^a	27	14	1.94	12	1	4	0	No	No
19 ^b	77	M	Acute cholecystitis	<i>E. coli</i>	Cefotaxime + metronidazole ^a	27	13	1.89	23	2	3	4	Yes	No ^d
20 ^b	53	M	Acute cholecystitis, pancreatitis, MODS	All cultures negatives	Cefotaxime + metronidazole	17	14	2.20	24	4	2	10	Yes	No ^d

^a Initial empiric antibiotic therapy had to be changed according to bacteriology ^b Postoperative patient. ^c Patient attained responder criteria after first HVHF ^d Late death by gastrointestinal bleeding

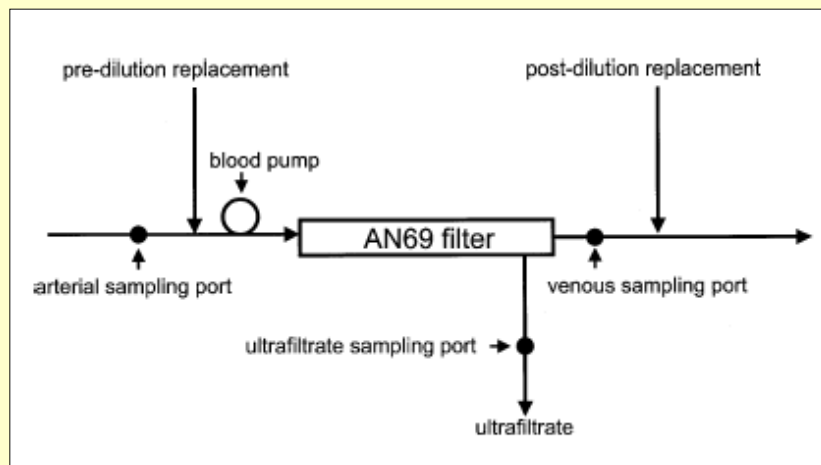
Cornejo, ICM 2005

antibióticos

Concentración plasma vancomicina v/s cantidad removida por HF



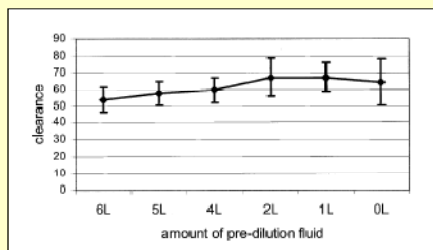
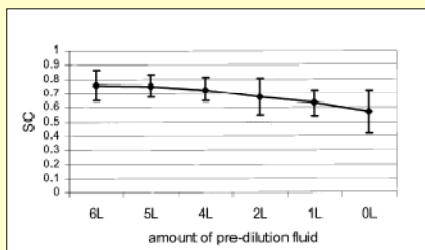
Cinética de vancomicina durante HFAV



Uchino, ICM 2002

Clearance de vancomicina y S.C. durante HFAV: impacto de la pre-dilución

- 7 pacientes con shock séptico y FOM.
- HVHF (6 L/h reposición) en proporciones variables pre y post-dilución.
- Reposición inicial pre-filtro (6 L/h pre-dilución).
- Dosis inicial de vancomicina: 1 g/día.
- Muestras pre-filtro, post-filtro y desde el ultrafiltrado a los 5 min del inicio de la HF.



Uchino, ICM 2002

La depuración de citoquinas depende no solo del tamaño del poro sino de la reposición

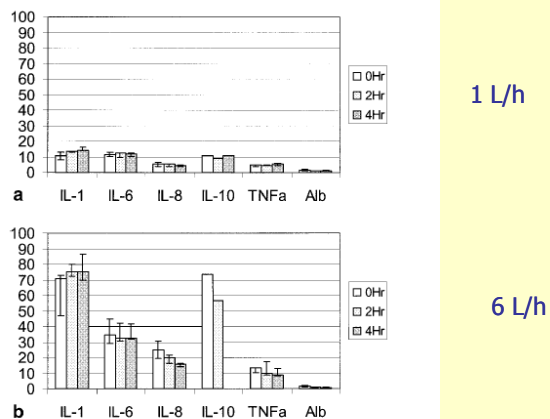


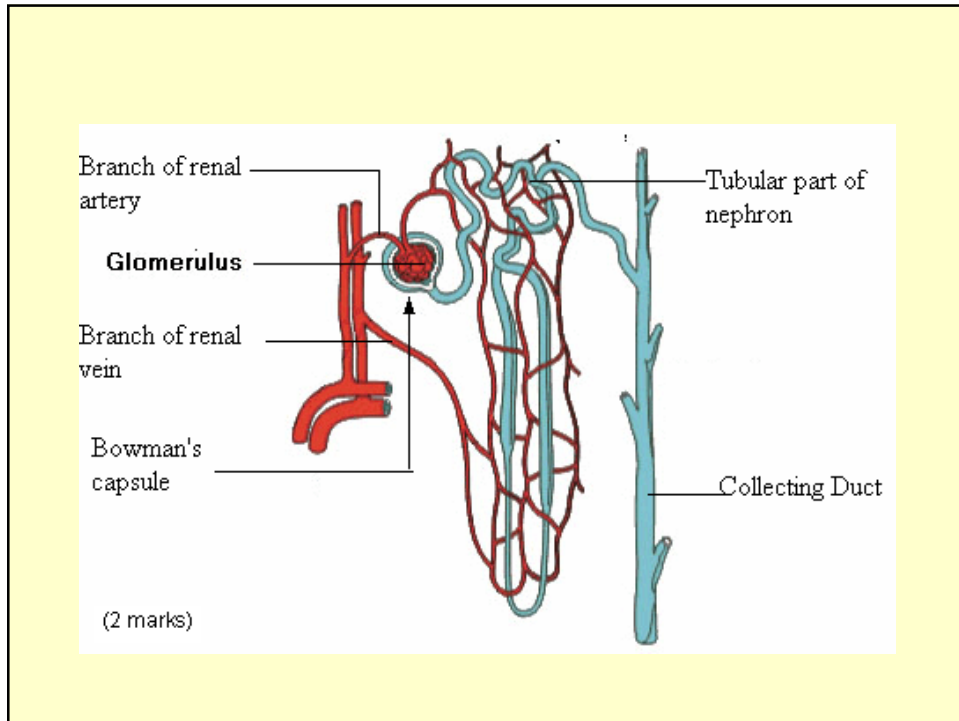
Fig. 2 Clearances of cytokines and albumin at (A) 1 l/h ultrafiltration and (B) 6 l/h ultrafiltration. The clearances of all cytokines were significantly improved by an increase of ultrafiltration rate from 1 l/h to 6l/h ($p<0.01$). There was no increase in albumin clearance between 1 l/h and 6l/h ($p=0.91$)

Uchino ICM 2002

La HFAV afecta los niveles plasmáticos de vancomicina

	Paciente 1	Paciente 2
nivel 0h (ug/ml)	34,7	10,8
nivel post-12h	9,7	3,7
% de reducción	72,0	65,7
creatinina 0h (mg/dl)	1,56	2,31
BUN (mg/dl)	35	39
Diuresis (ml/24h)	132	70

La reducción en los niveles plasmáticos fue 68,9% después de 12 h de HFAV. La contribución de la función renal endógena fue mínima ya que ambos individuos estaban oligúricos.



FIN

Prospective evaluation of short-term, high-volume isovolemic hemofiltration on the hemodynamic course and outcome in patients with intractable circulatory failure resulting from septic shock

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Thierry Dugernier, MD; Bruno Pirenne, MD; Genevieve Hanique, MD; James R. Matson, MD

CCM 2000

High-Volume Hemofiltration After Out-of-Hospital Cardiac Arrest

A Randomized Study

Ivan Laurent, MD,* Christophe Adrie, MD,† Christophe Vinsonneau, MD,* Alain Cariou, MD,*
Jean-Daniel Chiche, MD,* Alice Ohanessian, MD,‡ Christian Spaulding, MD,‡ Pierre Carli, MD,§
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OBJECTIVES	The study examined the effect of isovolumic high-volume hemofiltration (HF) alone or combined with mild hypothermia (HT) on survival after out-of-hospital cardiac arrest (OHCA) with initial ventricular fibrillation or asystole.
BACKGROUND	Global inflammation in response to whole-body ischemia-reperfusion is common after OHCA and may worsen the overall prognosis.
METHODS	<u>Sixty-one</u> patients admitted between May 2000 and March 2002 in the intensive care units of two hospitals in France were randomized to one of three groups: control, HF (200 ml/kg/h over 8 h) or HF+HT (32°C for 24 h) induced by cooling the HF substitution fluid. Standard supportive care was provided in all three groups. The primary end point was <u>survival</u> with a follow-up time of six months. The effect of HF on death by intractable shock was the secondary end point.
RESULTS	The six-month survival curves of the three groups were significantly different, with better survival in the HF group ($p = 0.026$) and in the HF+HT group ($p = 0.018$). After adjustment on baseline characteristics of cardiac arrest, HF (with or without HT) was associated with improved survival (logistic regression odds ratio, 4.4; 95% confidence interval [CI], 1.1 to 16.6). Compared to control group, the relative risk of death by intractable shock was 0.29 (95% CI, 0.09 to 0.91) in the HF+HT group and 0.21 (95% CI, 0.05 to 0.85) in the HF group.
CONCLUSIONS	The HF may improve the overall prognosis after resuscitation from OHCA. Combination of HF with mild HT is feasible and should be evaluated in larger trials. (J Am Coll Cardiol 2005;46:432-7) © 2005 by the American College of Cardiology Foundation

Características generales de los pacientes

Table 1. Baseline Characteristics of the Patients

Characteristic	Control Group (n = 19)	HF Group (n = 20)	HF+HT Group (n = 22)	p Value
Age, yrs	58 [53–64]	52 [47–59]	56 [50–70]	0.18
Female gender, n (%)	4 (21)	4 (20)	4 (18)	0.97
Arrest witnessed, n (%)	19 (100)	20 (100)	22 (100)	0.99
History of coronary heart disease, n (%)	2 (11)	6 (30)	3 (14)	0.22
Interval between collapse and first attempt at resuscitation (min)	4 [2–8]	5 [2–10]	4 [2–7]	0.79
Interval between first attempt at resuscitation and restoration of spontaneous circulation (min)	14 [10–15]	25 [10–38]	16 [8–25]	0.11
Asystole as the initial cardiac rhythm, n (%)	5 (26)	5 (25)	6 (27)	0.98
Number of shocks	3 [1–5]	3 [1–7]	3 [1–4]	0.38
Dose of epinephrine during resuscitation	1 [0–3]	6 [0–11]	3 [0–4]	0.09
Hypotension requiring continuous epinephrine on hospital admission, n (%)	4 (21)	8 (40)	6 (27)	0.41
Acute myocardial infarction, n (%)	9 (56)	9 (45)	9 (41)	0.38
Temperature at ICU admission (°C)	35.7 [34.9–36.3]	36.0 [35.3–36.5]	36.0 [34.7–36.3]	0.60
Temperature 4 h after ICU admission (°C)	37.4 [37.1–38.4]	37.3 [36.0–37.9]	31.7 [31.5–32.4]	0.0001

Continuous variables are reported as (medians) and [interquartile ranges]. Categorical variables are reported as counts and percentages.
HF = high-volume hemofiltration; HT = hypoheemia; ICU = intensive care unit.

Laurent, JACC 2005

En 21 pacientes con FRA en UCI se subestimó el Vurea en $23 \pm 18.2\%$.

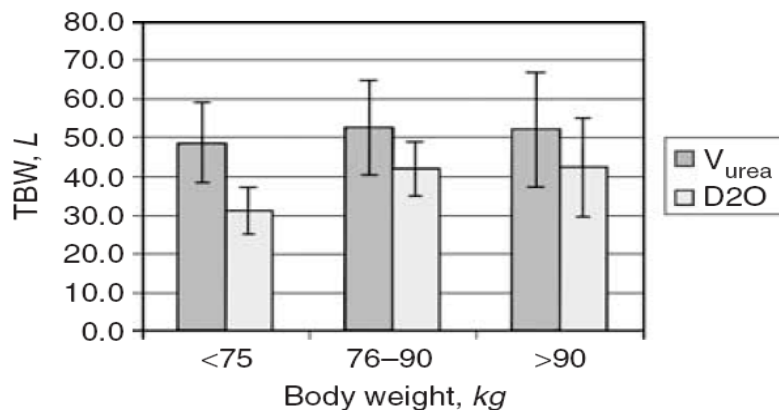


Fig. 2. Distribution of V_{urea} and total body water (TBW) by D_2O according to body weight.

Ikizler T. Kid Int. 2004;65:725-732

