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Iron Status in RDT Patients on EPO Therapy*M. Gonella, G. Calabre, A. Mazzotta, G. Pratesi, G. Vagelli*
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Purpose: In RDT patients large iron supplements are recommended to improve Epoetin (EPO) efficacy. In the present study iron status was compared between patients receiving EPO (Group 1) and not receiving EPO (Group 2). **Methods:** A group of 54 patients, apparently devoid of flogosis, was studied. They had been undergoing on-line HDF for at least 6 months and were receiving the same dose of carnitine, vitamin B6, vitamin B12 and folic acid supplements, but no AI compounds or ACE-inhibitors. Group 1 (n 32, F 21, BW 64 ± 14 kg, age 67 ± 11 years, dialytic age 68 ± 64 months) was receiving i.v.: EPO 67 ± 45 U/kg/wk and ferric gluconate 24 ± 11 mg/wk; Group 2 (n 22, F 7, BW 71 ± 12 kg, age 68 ± 11 years, dialytic age 67 ± 43 months) was receiving ferric gluconate 27 ± 11 mg/wk. After 3 months of this schedule, the parameters, reported below, were compared between the two Groups by using t-test for unpaired data. **Results:** Group 1 vs. Group 2: postdialytic Hb 12.9 ± 0.7 vs. 13.3 ± 1.3 g/dl, NS; serum ferritin 373 ± 123 vs. 150 ± 83 ng/ml, p < 0.000; serum iron 78 ± 24 vs. 77 ± 40 mcg/dl, NS; latent iron-binding capacity 182 ± 43 vs. 213 ± 55 mcg/dl, p < 0.001; transferrin saturation 32 ± 8 vs. 25 ± 10%, p < 0.02; hypochromic RBC 2 ± 1 vs. 6 ± 6%, p < 0.002; Kt/V 1.46 ± 0.12 vs. 1.36 ± 0.15, NS; sAlb 4.1 ± 0.3 vs. 4.0 ± 0.4 g/dl, NS; sB12 1,590 ± 280 vs. 1,280 ± 230 pg/ml, p < 0.002; sFolate 30 ± 10 vs. 20 ± 7 ng/ml, p < 0.02; sPTH 139 ± 171 vs. 167 ± 177 pg/ml, NS; CRP 0.6 ± 0.4 vs. 1.1 ± 0.6 mg/dl, NS. **Conclusions:** These data showed that the patients on EPO, despite receiving similar iron supplement and apparently utilizing it better, have a higher serum ferritin than those not on EPO. Therefore, iron status in RDT patients on EPO deserves further study.

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Blood Pressure Modifications in Hemodialysis Patients*I. Griveas, G. Visvardis, D. Papadopoulou, E. Mitsopoulos, P. Kyriklidou, E. Manou, E. Ginikopoulou, D. Meimaridou, L. Rosttein, G. Sakellariou*

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Purpose: Hypertension is a common finding in hemodialysis (HD) patients, contributes to cardiovascular disease and increases the risk of morbidity and/or mortality. Although volume expansion is

perhaps the major factor in the development of hypertension in HD patients, therapy with anti-hypertensive drugs is primarily indicated in the 25 to 30% of patients. This study was designed to estimate the blood pressure (BP) state of HD patients and to characterize the anti-hypertensive therapy. **Methods:** Among 160 HD patients, 129 (47 males) with age 60.81 ± 12.82 years were anti-hypertensive at the initiation of HD. They had been on HD for 72 ± 23 months and dialyzed for 4 hours three times/week. They were separated in two groups: I) hypertensive without treatment and: II) hypertensive with treatment receiving several numbers of anti-hypertensive drugs. **Results:** In 62 hypertensive HD patients (42%) removal of the excess sodium and attainment of 'dry weight' resulted in normalization of BP. 36 (27.9%) patients were on mono-therapy, 20 (15.5%) were on bi-therapy and 11 (8.5%) patients on tri-therapy or more. The therapeutic classes most often prescribed were beta-blockers (38.8%), calcium channel blockers (35.8%) and angiotensin converting enzyme inhibitors (25.3%). The most popular combinations of drugs were beta-blockers with calcium channel blockers and angiotensin converting enzyme inhibitors with calcium channel blockers. **Conclusions:** Control of the volume status normalized the BP in the majority of HD patients. In the rest of the patients mono-therapy or bi-therapy was needed. Beta-blockers, calcium channel blockers and angiotensin converting enzyme inhibitors were the most frequently prescribed anti-hypertensive medications.

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Blood Pressure Modifications in Hemodialysis (HD) Patients at the Initiation of HD in Comparison with Long Term HD Patients*G. Visvardis, I. Griveas, D. Papadopoulou, E. Mitsopoulos, P. Kyriklidou, E. Manou, D. Meimaridou, E. Ginikopoulou, L. Rosttein, G. Sakellariou*

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Purpose: Hypertension is a common finding in hemodialysis patients (HD). Control of the volume status can either normalize the blood pressure (BP) or make the hypertension easier to control. This study was designed to estimate the BP state among patients at the initiation of HD and older ones and to compare the antihypertensive therapy between two groups. **Methods:** Among 160 HD patients, 129 (47 male) with age 60.81 ± 12.82 years were hypertensive. They had been on HD for 72 ± 24 months and dialyzed for 4 hours three times/week. They were separated in two groups (A, B): A) hypertensives with HD therapy not more than 6 months and B) hypertensive with more than 6 months undergoing HD. **Results:** In group A,

32 patients were recruited and in group B, 97. Attainment of 'dry weight' resulted in normalization of BP in 13 patients (40.6%) of group A vs. 61 patients (62.86%) in group B. Patients received monotherapy were 63.15% in group A vs. 50% in group B, bi-therapy 11% (A) vs. 47% (B) and tri-therapy or more 26.31% (A) vs. 3% (B). The therapeutic classes most often prescribed were calcium channel blockers (38.32% vs. 36.06%), beta-blockers (29.4% vs. 29.5%) and angiotensin converting enzyme inhibitors (14.7% vs. 16.3%). **Conclusions:** Control of the extracellular volume expansion results in normalization or better management of BP in the majority of HD patients after 6 months under replacement therapy. Therapy with antihypertensive drugs was primarily indicated in 37% of patients in whom hypertension persisted despite seemingly adequate volume control (vs. 61% of patients at the initiation of HD). Calcium channel blockers, beta-blockers and angiotensin converting enzyme inhibitors were the most frequently prescribed antihypertensive medications. After 6 months of HD therapy only one or two drugs were needed to control BP.

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Blood Pressure (BP) Modifications in Diabetic Hemodialysis (HD) Patients in Comparison with Non-Diabetic HD Patients

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Purpose: Hypertension is a common finding in HD patients and especially in diabetics who appear to foster greater cardiovascular risk. This study was designed to estimate the BP state among diabetic HD patients and to compare antihypertensive therapy between diabetic and non-diabetic patients. **Methods:** Among 160 HD patients, 129 (47 male) with age 60.81 ± 12.82 years were hypertensive. They had been on HD for 72 ± 24 months and dialyzed for 4 hours three times/week. They were separated in two groups: A) diabetic HD patients and B) non-diabetic HD patients. **Results:** In group A 26 patients were recruited and in group B, 103. Attainment of 'dry weight' resulted in normalization of BP in 14 patients (60.86%) of group A vs. 44 patients (43%) in group B. Patients who received monotherapy were 58.33% in group A vs. 40.6% in group B, bi-therapy 16.66% (A) vs. 16.9% (B) and tri-therapy or more 16.66% (A) vs. 11.86% (B). The therapeutic classes most often prescribed in group A were: central sympathetic agonists 24%, calcium channel blockers, 21% angiotensin converting enzyme inhibitors, 12% and in group B calcium channel blockers, 33% beta-blockers, 24.17% angiotensin converting enzyme inhibitors, 13.18%. **Conclusions:** Control of the extracellular volume expansion results in normalization or better management of BP in the majority of HD patients. Therapy with antihypertensive drugs was primarily indicated in 39% of diabetic patients vs. 57% of non-diabetics. Central sympathetic agonists, calcium channel blockers and angiotensin converting enzyme inhibitors were the most frequently prescribed antihypertensive medications in diabetic patients. It is to be noticed that central sympathetic agonists were mostly used with two or more other antihypertensive medications but calcium channel blockers and

angiotensin converting enzyme inhibitors were prescribed as monotherapy or with the combination of another single medication.

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The Dysfunction of Arteriovenous Fistulas (AVF) in Relation to Plasma Homocysteine (HCY) Levels of Patients Undergoing Hemodialysis (HD)

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Purpose: It is well known that hyper-homocysteinemia (Hcy) is an independent factor for atherosclerosis. The prevalence of hyper-homocysteinemia is higher in patients with end stage renal failure than in the normal population. The aim of this study was to determine the relation of Hcy levels to AVF dysfunction. **Methods:** 50 patients (32 males) undergoing HD (4 hours/3 times a week) with duration of 26.44 ± 22.19 months were evaluated. 27 patients were hemodialyzed with low permeability dialyzers (low flux). Diabetic patients were excluded from the study. Hcy levels were measured before and six months after folic acid administration (5 mg/day). **Results:** Hcy levels were significantly higher ($p < 0.001$) before the folic acid administration. Patients with AVF dysfunction had significantly higher ($p < 0.004$) levels of plasma Hcy. There was no correlation between Hcy levels and the type of dialysis membrane. In patients with AVF dysfunction that improved, the Hcy levels had significantly decreased ($p < 0.001$). **Conclusions:** The serum Hcy levels in patients with end stage renal failure undergoing HD are related to AVF dysfunction and long term folic acid administration lowers its levels.

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The Influence of Hepatitis C and Iron Replacement Therapy on Plasma Pentosidine Levels in Hemodialysis Patients

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Purpose: The aim of this study was to assess the influence of hepatitis C (HCV) and intravenous iron therapy (IVIT) on oxidative stress (OS) in hemodialysis (HD) patients. **Methods:** 118 HD

patients (47% males, age 47 ± 13 years) were placed in two groups according to the presence (HCV+) or absence (HCV-) of serum antibodies against HCV. Plasma pentosidine, C-reactive protein (CRP), interleukin-6 (IL-6) and alanine aminotransferase (ALT) levels were measured. The patients were divided according to the serum levels of ferritin into tertiles: Group 1 (ferritin <380 ng/ml), Group 2 (ferritin $380-750$ ng/ml) and Group 3 (ferritin >750 ng/ml). The cumulative iron dose was recorded during 6 months prior to the study. **Results:** HCV+ patients, had higher levels of plasma pentosidine (median 104, range 13–230 pmol/mg) versus (104, range 25–233 pmol/mg), and ALT (29 ± 21 vs. 21 ± 25 U/l) compared with HCV- patients. Age, gender, S-Alb, IL-6 and CRP did not differ according to HCV serology. The patients in Group 3 presented with higher median levels of pentosidine (pmol/mg) and mean \pm SD cumulative dose of iron (mg/last six months) (106 [range, 27–230]) (745 ± 478) compared to Group 1 (99 [range, 43–175]) (694 ± 532) and Group 2 (79 [range 13–177]) (900 ± 474), respectively. Age, time on HD, S-Alb, CRP, IL-6 and the prevalence of HCV was not significantly different among the groups. Plasma pentosidine showed a positive correlation with age (Rho = 0.18; $p = 0.05$), HCV (Rho = 0.19; $p = 0.03$) and ferritin (Rho = 0.19; $p = 0.03$). Moreover, a positive significant correlation was found between ferritin and hematocrit (Rho = 0.22; $p < 0.01$) and cumulative dose of iron (Rho = 0.19; $p = 0.03$). **Conclusion:** We conclude that patients with HCV and elevated ferritin levels have increased circulating levels of pentosidine, suggesting that the presence of hepatitis C and iron overload may intensify oxidative stress in HD patients.

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Procalcitonin as a New Marker of Inflammation in Comparison to Other Inflammation Markers in Diabetic Haemodialysis (HD) Patients

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Purpose: Procalcitonin (PCT) has been confirmed in numerous studies as a strong marker of inflammation in the field of infectious diseases. On the other hand, it has not been extensively studied in HD patients and especially in diabetic HD patients where morbidity and mortality are considerably higher than in non diabetics. The objective of this study was to evaluate the diagnostic value of serum PCT in diabetic HD patients and its correlation to other traditional inflammatory markers. **Methods:** We measured plasma PCT levels in 26 diabetic patients on maintenance HD (9 males, age: 65.3 ± 9.4 years, on dialysis for 23.9 ± 10.8 months, 12h/week). PCT levels were compared with other markers of inflammation including C-reactive protein (CRP), interleukin-6 (IL-6), prealbumin, leukocytes, urea, creatinine, albumin, haemoglobin (Hb), ferritin and epoetin (Epo) doses. Relations between parameters were studied by Spearman's correlation.

Results: PCT concentrations were lower than the upper normal limit of 0.5 ng/ml in 26% of the patients. PCT values were high in patients with an inflammatory status, while IL-6 values were elevated in all patients regardless of infection status (IL-6: 17.5 ± 18.2 pg/ml $M \pm SD$, normal values <3.13 pg/ml). Pre-albumin concentrations were 0.24 ± 0.08 g/L ($M \pm SD$) (normal values: 0.2–0.4 g/L). Plasma CRP concentrations were 2.3 ± 3.1 mg/L ($M \pm SD$) and with IL-6 were positively correlated to each other. Hb was negatively correlated with prealbumin and Epo doses, while Epo doses were positively correlated with CRP. **Conclusion:** PCT seems to be a reliable marker of inflammation in HD patients. The combination of elevated IL-6 and CRP levels was associated with an altered nutritional status and a decreased sensitivity to Epo. The concomitant elevations in PCT, CRP and IL-6 could be more sensitive in the evaluation of inflammation than each marker separately but further and longer studies are needed for more solid conclusions.

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Procalcitonin as a New Marker of Inflammation in Elderly Haemodialysis (HD) Patients

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Purpose: The morbidity and mortality rate is high among HD patients and recent evidence suggests that this may be linked to chronic inflammation. Procalcitonin (PCT) has been confirmed in numerous studies as a strong marker of inflammation in the field of infectious diseases. The objective of this study was to evaluate the diagnostic value of serum PCT in elderly HD patients (>60 years old) and its correlation to other traditional inflammatory markers. **Methods:** We measured plasma PCT levels in 88 patients on maintenance HD (43 males, age: 71 ± 4.4 years, on dialysis for 26 ± 21.9 months, 12h/week). PCT levels were compared with other markers of inflammation including C-reactive protein (CRP), interleukin-6 (IL-6), pre-albumin, leukocytes, urea, creatinine, albumin, haemoglobin (Hb), ferritin and epoetin (Epo) doses. Relations between parameters were studied by Spearman's correlation. **Results:** PCT concentrations were lower than the upper normal limit of 0.5 ng/ml in 60.22% of the patients. PCT values were high in patients with an inflammatory status, while IL-6 values were elevated in all patients regardless of infection status (IL-6: 11.2 ± 14.4 pg/ml $M \pm SD$, normal values <3.13 pg/ml). Pre-albumin concentrations were 0.26 ± 0.10 g/L ($M \pm SD$) (normal values: 0.2–0.4 g/L). Plasma CRP concentrations were 1.64 ± 3.43 mg/L ($M \pm SD$) and with PCT and IL-6 concentrations were positively correlated to each other. Pre-albumin was negatively correlated with IL-6 and Epo doses. **Conclusions:** PCT seems to be a reliable marker of inflammation in HD patients. The combination of elevated IL-6 and CRP levels was associated with an altered nutritional status. The concomitant elevations in PCT, CRP and IL-6 could be more sensitive in the evaluation of inflammation than each marker separately but further and longer studies are needed for more solid conclusions.

Impact of Left Ventricular Patterns and Diastolic Dysfunction on Hemodialysis Patients

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Background: Left ventricular hypertrophy is the main manifestation of uremic cardiomyopathy and predicts both cardiovascular events and death independent of conventional risk factors. Diastolic dysfunction is often associated with left ventricular hypertrophy and accounts for up to 30% of heart failure. The aim of this study was to estimate the impact and the prevalence of left ventricular hypertrophy, its geometric models and diastolic dysfunction on hemodialysis patients, as well as the relationships with cardiac troponin, a specific marker of myocardial damage. **Methods:** 31 patients (26 on hemodialysis, 5 on peritoneal dialysis) and 31 normal healthy subjects, as a control group, were enrolled. Echocardiographic measurements were carried out according to the recommendations of the American Society of Echocardiography. Left ventricular mass was calculated according to the Devereux formula and indexed to height. 2.7 Doppler echocardiography was performed to study diastolic function by measurements of isovolumetric relaxation period (IVRT), E wave deceleration time (DTE) and E/A ratio. Cardiac troponin was measured by a third generation electrochemiluminescence immunoassay. Statistical analysis was performed by t-test for the comparison among groups, and correlations were sought using the Pearson and the Spearman's correlation test. p values of <0.05 was considered to be statistically significant. **Results:** Eccentric hypertrophy was the most frequent pattern (n = 17; 55%), followed by normal cardiac geometry (n = 7; 23%) and concentric hypertrophy (n = 5; 16%). Only a minority of patients (n = 2; 6%) showed a concentric remodeling. Systolic dysfunction was present in 3 patients (FE < 50%): E/A was negatively correlated with age (r = -0.41; p = 0.02), DTE was positively correlated with posterior wall thickness (r = 0.36; p = 0.05) and interventricular septum thickness (r = 0.45; p = 0.01), cardiac troponin was positively correlated with age (r = 0.50; p = 0.00), left ventricular mass (r = 0.41; p = 0.02), posterior wall thickness (r = 0.41; p = 0.02) and interventricular septum thickness (r = 0.39; p = 0.03) but not with diastolic dysfunction parameters. There were no significant differences among groups with normal left ventricular geometry and left ventricular hypertrophy in duration of dialytic treatment, but a significant statistical difference was noted in relationship to age (p = 0.03). The patients with major diastolic dysfunction were affected with frequent hypotensive episodes during dialytic sessions. **Conclusions:** Left ventricular hypertrophy is associated with diastolic dysfunction, both cause of hypotensive episodes during dialytic treatments and of heart failure in patients with normal systolic function. Non invasive assessment of left ventricular diastolic function, would represent an important advance in the diagnosis and in the prevention of heart failure in hemodialysis patients.

Dramatic Reversal of Acute Renal Failure (ARF) with Therapeutic Plasma Exchange (TPE) in a Case of Multiple Myeloma

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Introduction: ARF in the setting of multiple myeloma could be attributed to numerous etiologies including volume depletion, hypercalcemia and myeloma kidney from cast nephropathy. We present a case of IgA myeloma induced ARF that responded dramatically to TPE without need for renal replacement therapy (RRT). **Case Report:** A 50 y/o white male hypertensive patient was seen for back pain and weight loss. Exam was unremarkable. Baseline labs: normal anion gap, serum proteins -9.8 g/dl, albumin of 3 g/dl and urine sediment with WBC casts. Renal functions: see table below. Serum protein electrophoresis (SPEP)/immunofixation (IFE) showed IgA spike (3.7 g/dl) and lambda light chains. Urine protein electrophoresis (UPEP)/IFE showed lambda light chains to be 94% of the 4.3 g/dl proteinuria. Ionized Calcium was elevated at 1.93 mEq/l; bone survey found multiple lytic lesions. Marrow aspirate confirmed myeloma.

Admission	(Day 1)	Pre-TPE (Day 3)	S/P-TPE (Day 10)	(Day 17)
BUN (mg%)	113	98	23	20
Creatinine (mg%)	7.2	6.9	2.1	1.4

The patient was initially treated with hydration, alkaline diuresis and calcitonin. Renal function remained essentially unchanged for 48 hours after admission despite improvement of hypercalcemia. TPE was initiated and six 4.5L exchanges were performed with 5% albumin as replacement fluid. Chemotherapy was initiated with VAD (vincristine, adriamycin, dexamethasone). Renal function improved dramatically and the patient did not require RRT for his ARF. Repeat SPEP/UPEP with IFE showed a marked decline in monoclonal proteins. Rapidity of the decline in monoclonal proteins was interpreted to be more likely a result of the TPE than from the initiation of chemotherapy. **Conclusion:** Our experience supports previous reports that TPE can result in a rapid improvement in light-chain associated ARF in the context of multiple myeloma.

Effect of Hemodialysis Combined with Ultrafiltration on Thermal Parameters, Skin Blood Flow, and Energy Expenditure

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Purpose: The cause of the increase in core temperature (CT) during hemodialysis (HD) is still under debate. It has been suggested that peripheral vasoconstriction due to hypovolemia, leading to a reduced dissipation of heat from the skin, is the main cause for this increase in CT. If so, it would be expected that extracorporeal cooling (Jex) needed to maintain a stable CT (isothermic) would be largely different between isothermic HD combined with ultrafiltration (UF) and isothermic HD without UF (isovolemic). Consequently, significant differences in Δ CT would be expected between isovolemic HD at zero Jex (thermoneutral) as compared to HD combined with UF at zero Jex. **Methods:** In the present study, changes in thermal parameters (CT and Jex measured with a blood temperature monitor), skin blood flow (SBF, measured with a laser doppler flowmeter), and energy expenditure (EE, measured by indirect calorimetry) were compared in 13 patients, each undergoing these 4 different dialysis treatments. **Results:** CT increased significantly during thermoneutral treatments, both with (0.32°C ; $p = 0.000$) and without ($0.28 \pm 0.29^{\circ}\text{C}$; $p = 0.006$) UF. There were no significant differences between these 2 sessions. In isothermic treatments the relationship between Jex and UF tended to be significant ($r = -0.51$; $p = 0.07$), however, there was no significant difference in cooling requirements whether treatments were done without ($-16.5 \pm 6.6\text{ W}$) or with UF ($-18.1 \pm 7.7\text{ W}$). With UF the decline in SBF was significantly larger during isothermic ($-0.93 \pm 0.59\text{ PU}$) as compared to thermoneutral ($-0.45 \pm 0.87\text{ PU}$) ($p = 0.04$), whereas SBF did not change during the isovolemic sessions, respectively. Changes in EE did not differ between the 4 treatment modes. **Conclusions:** Although fluid removal has an effect on thermal parameters, it appears that hypovolemia or a reduction in SBF is not the sole cause for the increase in CT during HD. Other factors such as mediators of inflammation might be responsible for the observed effects.

Medical Quality Management of Hemodialysis Affects Quality Targets for Improvement Differently

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Introduction: Continuous quality improvement (CQI) based on benchmarking of validated quality indicators is the essential component of monitoring of dialysis quality. QiN (Quality in Nephrology) is the established QM-system of the German largest dialysis provider, KfH with which targets of quality improvement are identified. **Methods:** Uniform electronic patient charts and standardized operating procedures (SOPs) for data input are the prerequisites for successful implementation. Electronical and pseudonymized data transmission as well as short-term analysis and unit-specific feedback on performance are further mainstays for growing acceptability by dialysis units. Process quality is measured in five categories (1) 'adequacy of dialysis'; (2) 'renal anemia', (3) 'nutrition/chronic inflammation'; (4) 'hypertension' and (5) 'calcium-phosphate metabolism', each of which contain several quality indicators (see table). **Results:** More than fifty percent of KfH dialysis units covering over 6,600 patients have adopted QiN since 1999. Renal anemia (I) and adequacy of dialysis (II) have been profoundly improved during the four years (see table). However, hemoglobin and dialysis duration have reached a plateau level from which no further improvement seems achievable. Hypertension (III) has merely improved and nutritive status (IV) and calcium-phosphate metabolism (V) have shown practically no change (see table).

Quality target Quality indicator	Q 1/99 (n = 625)	Q 1/03 (n = 6,602)	% change
I. Anemia			
Hematocrit ([Vol. %], mean)	31.6	35.1	+11
rel. Epo ([IU/kg], median)	72.0	73.4	+2
II. Dialysis adequacy			
Kt/V (mean)	1.31	1.52	+16
Duration <4 h ([%], mean)	34	20	-41
III. Hypertension			
Predialysis systolic blood pressure ([mmHg], mean)	143.7	138.1	-4
IV. Nutrition			
Albumin ([g/l], median)	38.5	39.0	+1
V. Calcium-phosphate			
Calcium-phosphate product ([mmol ² /l ²], mean)	4.4	4.3	-2

Conclusion: Quality targets differ in their accessibility towards quality improvement technology. Indicators which are primarily staff dependent and can be addressed within shorter periods of time (i.e. dialysis time, anemia) have substantially improved. The fact that hypertension, nutrition and calcium-phosphate metabolism have not profoundly changed could be explained by higher complexity of the quality targets and higher dependency on patient compliance. In order to improve the entire spectrum of end-stage renal disease, further methods of quality management beyond feedback on performance seem necessary.

Using Ultrapure Dialysate in Hemodialysis Improves the Erythrocyte Life Span and Erythropoiesis

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Introduction: In humans, creatine content in erythrocytes is used to measure erythrocyte life span and erythropoietic capacity, since it rapidly declines as the erythrocyte ages. Erythropoietin therapy is useful in ameliorating renal anemia. The acute or chronic inflammatory processes may lead to marked resistance to rHu-EPO. It is a well-known fact that exposure of patient's blood to even mildly contaminated dialysate contributes to induce cytokine synthesis. However, there are no data indicating whether differences in microbiological quality of the dialysate may affect the renal anemia in patients receiving regular hemodialysis. The aim of our prospective investigations was to compare the effect of potentially contaminated, commercial (unfiltered) and on-line produced, ultrapure dialysate on renal anemia. **Patients and Methods:** Sixty-one stable anuric dialysis patients gave informed consent to participate in this study. They all had normocytic, normo-chromic anemia of end-stage renal disease. None of the patients had acute or chronic infection, inflammatory disease, malignancy or chronic bleeding disorders. All were on bicarbonate dialysis (3–4 h/3 times a week), using polysulfone, cellulose or polyamide hollow fiber dialyzers. The ultrapure dialysate was employed for hemodialysis without changing the dialysis schedule and other conditions. Total RBC counts, reticulocyte counts, hemato-crit, hemoglobin, serum level of total protein, serum level of ferritin and RBC creatine were monitored monthly. **Results and Discussion:** The hematocrit and reticulocyte counts significantly increased after initiation of ultrapure dialysate (hematocrit; 28.8 ± 4.7 vs. $30.9 \pm 3.1\%$, reticulocyte counts; 4.077 ± 1.38 vs. 4.657 ± 1.53 $10^4/l$). The serum level of ferritin rapidly decreased after using the ultrapure dialysate. These results indicated that erythropoiesis was stimulated by ultrapure dialysate. Whereas the RBC creatine significantly increased from second month to ninth month and gradually decreased to baseline level. Considering the increased number of reticulocyte counts, RBC life span was extended by using the ultrapure dialysate.

Reduced End-Systolic Elastance Indicating Poor Left Ventricular Contractility in Hemodialysis Patients

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Introduction: Left ventricular (LV) hypertrophy, myocardial fibrosis and ischemia are prevalent in hemodialysis (HD) patients and can lead to impaired myocardial performance. Systolic LV function in

hemodialysis (HD) patients is usually reported to be normal. However, commonly used parameters are load-dependent, and reflect both cardiac filling and peripheral resistance. End-systolic elastance (Ees) is a less load-dependent parameter of myocardial contractility. It can be assessed from LV responses to preload changes from simultaneous pressure and volume measurements. The acute LV response to preload reduction by nitroglycerine (NTG) was tested to assess Ees. **Methods:** Seven patients were tested before HD. Continuous arterial blood pressure was measured by Finapres as surrogate for LV pressure. Routine echocardiographic measurement of ejection fraction (EF) was done at baseline. LV cavity area was measured using automated border detection as surrogate for LV volume. Systolic blood pressure (SBP) and LV area data were combined on-line to create pressure-area loops in real time following intravenous NTG bolus. Initial dose was 0.5 mg. If SBP decrease was <20 mmHg, 1 mg was given. Ees was determined off-line by single beat analysis of consecutive pressure-area loops, starting from the SBP decline following NTG bolus. All data are median values (range). **Results:** SBP decline was 36 mmHg (26–73). EF was 46% (27–58). Ees was 8.9 mmHg.cm⁻² (1.9–21.9). Ees was low compared to Ees values estimated from pressure-area loops in previous studies, in which non-uremic patients were measured before undergoing coronary bypass surgery. This low Ees indicates poor LV performance. Indeed, the patient with the lowest Ees had a low EF. However, despite low Ees values, EF measurement indicated reasonable systolic function in the other patients. The latter may be due to adaptations in peripheral resistance. **Conclusion:** We conclude that LV performance in HD patients is worse than apparent from conventional measurements. Reduced myocardial contractility could play an important role in the genesis of intradialytic hypotension.

Relevance of Procalcitonin Levels in Comparison to Other Markers of Inflammation in Haemodialysis (HD) Patients

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Purpose: The annual mortality rate of HD patients remains high despite the marked improvement in dialysis technology and patients care. Recent evidence suggests that this may be caused to inflammation. Procalcitonin (PCT) has been confirmed in numerous studies as a strong marker of inflammation in the fields of infectious diseases. The objective of this study was to evaluate the diagnostic value of serum PCT in HD patients and its correlation to other traditional inflammatory markers. **Methods:** We measured plasma PCT levels in 120 patients on maintenance HD (71 male, age 63 ± 11.72 years, on dialysis for 55.6 ± 93.03 months, 12 h/week). PCT levels were compared with other markers of inflammation including C-reactive protein (CRP), interleukin-6 (IL-6), pre-albumin, leukocytes, urea, creatinine, albumin, haemoglobin (Hb), ferritin and epoetin (Epo) doses. Relations between parameters were studied by Spearman's correlation. **Results:** PCT concentrations were higher than the upper

normal limit of 0.5 ng/ml in 38% of the patients. PCT values were high in patients with an inflammatory status, while IL-6 values were elevated in all patients regardless of infection status (IL-6: 12.7 ± 24.1 pg/ml $M \pm SD$, normal values <3.13 pg/ml). Pre-albumin concentrations were 0.27 ± 0.10 g/L ($M \pm SD$) (normal values: 0.2–0.4 g/L). Plasma CRP concentrations were 1.1 ± 3.6 mg/L ($M \pm SD$) and with IL-6 were positively correlated to each other. Pre-albumin was negatively correlated with CRP and IL-6. Hb was negatively correlated with pre-albumin and Epo doses, while Epo doses were positively correlated with CRP. **Conclusions:** PCT is a reliable marker of inflammation in HD patients. The combination of elevated IL-6 and CRP levels was associated with an altered nutritional status. The concomitant elevations in PCT, CRP and IL-6 could more sensitive in the evaluation of inflammation than each marker separately.

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Serum Cystatin-C Concentration as a Marker of Glomerular Filtration Rate in Patients with and without Renal Diseases

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Purpose: The assessment of the glomerular filtration rate (GFR) is the most commonly used test of renal function. Cystatin-C, a cysteine protease inhibitor, which can be measured by light scattering immunoassay, possesses many of the attributes required of the ideal GFR marker. On the other hand many endogenous markers which are widely used for the estimation of GFR such as serum creatinine (SCr) are not ideal and do not perform optimally in certain clinical settings. The present study was undertaken to evaluate clinical application of serum cystatin-C (CysC) as a new marker of GFR in patients with normal renal function or various renal diseases. **Methods:** A total of 49 patients (21 male) were enrolled in the study (age: 53.4 years, range: 18–80). We measured serum CysC levels and compared them with SCr, creatinine clearance (CCr), Cockcroft-Gault equation (CG), MDRD as an indicator of GFR. Spearman's correlation coefficients were used to determine the relationship between CysC and other markers. **Results:** There was a significant positive correlation between serum CysC and SCr ($r = 0.750$). Moreover, the CysC level was positively correlated with CG ($r = 0.762$) with CCr ($r = 0.623$) and with MDRD ($r = 0.751$). **Conclusions:** These results indicated that measurement of serum cystatin-C was useful and accurate for estimation of GFR. Recent literature confirms our data although there are concerns about non renal influences. Although serum CysC can generally be recommended as a marker of GFR, our study is still in progress in order to confirm and validate in a larger number of patients with special problems such as transplantation and cancer.

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The Influence of Hemodiafiltration on Plasma Amino-thiol Redox Status

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Purpose: Hemodialysis (HD) has been recently shown to decrease plasma amino-thiol levels and the proportion of their oxidized to reduced forms, i.e. the redox status. Increasing use of convective dialysis methods, most notably hemodiafiltration (HDF), prompted us to investigate the effect of this technique on the plasma redox status of proatherogenic aminothiols, i.e. homocysteine (HCSH) and cysteine (CSH) and antiatherogenic compounds: glutathione (GSH) and cysteinylglycine (CGSH). **Methods:** Fourteen non-diabetic, long-term chronic dialysis patients (6M, 8F; mean age 28.2 ± 15.5 years) were included. Total plasma and reduced forms of aminothiols, albumin, ferritin, vitamin B12 and folate levels, hematocrit, residual renal function and dialysis adequacy parameters were measured in all subjects prior to and after a single mid-week hemodiafiltration session (predilution, with on-line production of the substitution fluid). The results were compared with those obtained before and after a standard hemodialysis session performed with modified cellulose membranes. Redox status of each of the amino-thiol compounds was calculated as a proportion of (total reduced)/reduced concentration. Proatherogenic amino-thiol redox index (HCSH + CSH) and antiatherogenic index (GSH + CGSH) were calculated. Plasma aminothiols were assessed with high-performance liquid chromatography. To prevent the oxidation of the reduced species 2-chloro-1-methylquinolinium tetrafluoroborate was immediately added after blood collection. **Results:** Serum albumin, ferritin, vitamin B12 and folate levels were within the normal range in all patients. Urea reduction ratios were similar. HDF induced a significant decrease of HCSH+CSH redox status (from 10.3 ± 3.9 to 7.0 ± 6.0 ; $p = 0.04$) but also of GSH+CGSH redox status (from 4.4 ± 2.5 to 2.1 ± 1.0 ; $p < 0.001$). Neither of these indexes was significantly influenced by the standard hemodialysis (11.7 ± 5.0 vs. 9.8 ± 5.0 and 4.3 ± 1.8 vs. 5.5 ± 2.6 , respectively). **Conclusions:** We found that hemodiafiltration may decrease the proatherogenic amino-thiol redox status but it may be counteracted by the simultaneous decrease of the redox status of other thiol compounds which show antiatherogenic properties. Whether the net effect of HDF on plasma amino-thiol oxidation balance is more favorable than that of HD, remains to be proven in a long-term study.

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Size Exclusion and Tailor made Functionalized Membranes for Elimination of Toxins

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Background: Removal of toxins, i.e. endotoxins, metabolic waste products, excessive amounts of high molecular weight products is mainly done by diffusive or convective operation modes/therapies

using size exclusion membranes. Adsorptive devices (mainly bead filled columns) have shown their potential removing selectively components from plasma or blood. Currently, new generations of membranes combining separation principles of membranes and beads are under development. **Results:** We will demonstrate the characteristics of tailor made hydrophilic size exclusion membranes prepared from high-Tg polymers. The separation advantages of a whole class of new tailor made size exclusion membranes (from nano- up to micro-porous membranes) will be shown, i.e., diffusion and sieving data for a number of substances covering a broad Mw spectrum (35 up to 350,000 Da). To fully characterize the membranes biocompatibility data will be presented. In a second part, the advantages of a membrane, which combines two separation principles (size exclusion and adsorption) to allow selective toxin separation from blood, plasma or water using a single device will be shown. The separation principle (toxin separation data) and the formation procedure of these membranes will be presented. We will demonstrate how this unique membrane formation technology will allow to tailor membranes for selective removal of substances based on their interaction with the ligand present on the membrane or their colligative properties. In the future this will allow the formation a whole group of membranes for selective separation therapies. **Conclusions:** The characterization data presented for both membrane types will form a detailed picture of their therapeutic application range and their advantages for the different therapies/operation modes discussed.

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On-line Hemodiafiltration (HDF) Makes Dialysis Treatment More Tolerable for Many Patients

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Methods: A survey was conducted to document current practice of on-line HDF for chronic dialysis, asking for subjectively assessed clinical benefits in comparison to hemodialysis. Data on 223 patients presently on HDF treatment was kindly provided by 75 dialysis units in 8 Western European countries. **Results:** Patients were 69% males, 57 ± 15 years old, had a dry weight of 76 ± 17 kg, and had been on HDF for 19 ± 19 months. Diabetes was the primary cause of renal failure in 25% of cases. The HDF treatment was performed for 4.4 ± 0.6 h, at a QB of 324 ± 62 ml/min. Postdilution was used for 68% of patients with an infusion volume (VINf) of 19 ± 6 L. In predilution mode the VINf was 30 ± 14 L. A need for improved blood purification (Kt/V, phosphate, Beta 2m) was given as the major reason for starting HDF in 52% of patients. Intra-dialytic hypotension (31%) and symptoms (27%), mainly itching, neuropathy, and fatigue, were other frequent reasons to start HDF. Compared to the previous therapy (which was low-flux in 62%) treatment tolerance was stated to improve from the change to on-line HDF as shown below.

	Prevalence (%)	No. of cases improved (%)
Symptomatic hypotension	57	66
Muscle cramps	51	52
Itching	49	53
Fatigue	57	60

Since starting with HDF considerable improvement was noted in quality of life for 60%, in hypertension management for 35%, in anemia management for 26%, and in hyperphosphatemia for 36% of patients. A similar ongoing survey indicates that ESRD patients on on-line hemofiltration (HF) are predominantly females and have lower body weight, and that HF is successfully used to alleviate cardiovascular instability during treatment. **Conclusions:** Apart from improved blood purification HDF has the potential to improve treatment tolerance in a significant way and to facilitate management of blood pressure, anemia and hyperphosphatemia.

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Lipid Profiles in Acidotic and Non-Acidotic Hemodialysis Patients

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Introduction: Uremic dyslipidemia has been attributed to different factors, including metabolic acidosis. While correction of acidosis has been previously shown to lower serum triglyceride levels in a group of pediatric patients on hemodialysis (Mak, RH. *Pediatr Nephrol* 1999;13:891–893), the role of metabolic acidosis in uremic dyslipidemia in adults has not been well elucidated. This study aimed to determine the effects of acidosis on lipid profiles in adult hemodialysis patients. **Methods:** Fasting lipid profiles, pre-dialysis serum chemistries and intact PTH levels were obtained from patients undergoing maintenance hemodialysis at two centers. Patients were divided into two groups: the first, patients with serum bicarbonate levels less than 20 meq/L and the second, with serum bicarbonate levels greater than or equal to 20 meq/L. Means of lipid levels, BUN, creatinine, intact PTH levels, total calcium and phosphorus levels were compared between the two groups using standard t-tests. **Results:** 113 of 145 hemodialysis patients were not on lipid-lowering agents. 52 patients had serum bicarbonate levels less than 20 meq/L, and 67 had levels equal to or greater than 20 meq/L. Total cholesterol, HDL, triglyceride and LDL levels were not significantly different between the two groups. There were no differences seen in calcium, phosphorus, PTH, BUN and creatinine levels. **Conclusions:** Based on this cross-sectional study, lipid profiles were not significantly different between acidotic and non-acidotic hemodialysis patients. Further studies are needed to determine the role of acidosis and its correction on uremic dyslipidemia.

Investigation of Cumulative Patency Rate of Native Arteriovenous Fistulae of Chronic Hemodialysis Patients

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The types of blood access in hemodialysis (HD) patients include native arteriovenous fistula (nAVF), replacement with artificial graft, long-term catheter retention, etc. In the case of chronic HD patients in Japan, the nAVF accounts for 90% or more because the access has to be used for a long term. However, along with an increase in the incidence of diabetic nephropathy and elderly HD patients as well as the increase in the patients undergoing long-term dialysis for 20 years or more, the number of access troubles is on the increase each year.

Aim: We investigated the cumulative patency rate of blood access with focus on the cumulative patency rate in the nAVF and risk factors for patency. **Patients and Methods:** The cumulative patency rate of blood access was investigated in 618 limbs by nAVF. The cumulative patency rate by primary disease (non-diabetes mellitus, diabetes mellitus), by age at the time of operation (<60 years old, >60 years old), by gender (male, female), by condition (introduction, surgical revision) and by site (wrist, forearm, elbow joint, brachium). Each cumulative patency rate was calculated by Kaplan-Meier method. **Results:** The cumulative patency rates of nAVF after 1, 2, 3, 5 and 10 years were 85.6%, 78.9%, 75.0%, 67.5% and 52.2%, respectively. The primary access failure rate (within 1 month) was 2.3%. When the influence on the cumulative patency rate was investigated, no significant difference was observed by primary disease, by age at the time of operation and by condition. However, the cumulative patency rate by gender, the rate was significantly higher in the males. **Conclusion:** The nAVF is considered as the blood access method with the highest patency rate in the chronic HD patients. However, the risk of patency is influenced by gender, especially female.

Barrier Function of Low and High Flux Synthetic Membranes for Endotoxins in Contaminated Dialysis Fluid

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Purpose: Synthetic low and high flux dialyzers are widely used because of their superior removal efficacy for uremic toxins and biocompatibility. In case of backfiltration strong requirements on microbiological quality of dialysis fluid and barrier function of the dialyser membrane are demanded to avoid activation of chronic proinflammatory processes in HD patients. Backfiltration may vary considerably depending on dialyser design (fiber dimension, surface area), membrane permeability (pore size and distribution, ultrafiltration coefficient) and treatment conditions (blood flow rate, blood

viscosity, weight loss rate). Therefore we investigated retention behaviour for endotoxins of synthetic low and high flux dialyzers (Polyflux steam sterilized) under controlled backfiltration conditions by measuring transfer of endotoxin (concentration and biological activity) in an in vitro set-up. **Methods:** Blood compartment was perfused (Q_b, in 300 ml/min) with bicarbonate dialysis fluid containing 20% human plasma, and dialysate side (Q_d, in 200 ml/min) with bicarbonate dialysis fluid spiked with endotoxins (LPS from *E. coli* 055:B5, 500–1,000 EU/ml). Backfiltration (50 ml/min) was controlled by adjusting pump speeds accordingly. LPS content in both compartments was measured for 20 min (chromogenic kinetic LAL assay). Biological activity of backfiltered fluid was measured by IL-1- α release in whole blood. **Results:** The synthetic low and high flux membranes in different types of Polyflux dialyzers exhibit a comparable adsorptive capacity for endotoxins leading to the following logarithmic retention values (LRV = Log(C_b/C_d): low flux Polyflux 14L: LRV = 3.2, and high flux Polyflux 170H: LRV = 3.3. Analysis of biological activity revealed a similar reduction of IL-1- α release in whole blood. **Conclusions:** Synthetic Polyflux low flux and high flux dialyser membranes provide an effective barrier against endotoxins and related biological activity. As long as microbiological quality standards for dialysis water (e.g. Eur. Pharm. endotoxin <0.25 EU/ml) are fulfilled, this barrier function for LPS appears to be sufficiently protective during hemodialysis treatments with backfiltration when considering both the threshold for LPS-dependent IL-1- α induction and quality standards for infusion fluids.

Regional Differences in Survival Benefit of HAART in ESRD Patients with HIV/AIDS Associated Nephropathy (HIVAN) in USA

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We have previously shown significant improvement in survival on dialysis of ESRD patients from HIVAN in the highly active antiretroviral therapy (HAART) era. i.e. median survival time for pre-HAART is 0.99 year (± 0.03) compared to 2.18 year (± 0.10) in HAART group ($p < 0.01$) (unpublished data). **Objective:** To assess for any regional differences in survival benefit of HAART during the study period (Jan 1996–May 2000). **Methods:** Analysis was done on prospectively collected data from the ESRD Medical Evidence Report forms (HCFA-2728) and death notification forms as archived in the Standard Analysis Files of the United States Renal Data Systems (USRDS May 2000). All patients with primary cause of ESRD reported as HIVAN were identified ($n = 6,158$). Sequential Cox Multivariate regression analysis was done with age, gender, body mass index, race, diabetic status, hemoglobin, dialysis modality and ESRD network location in the pre-HAART and HAART era (before and after 1/1/96 respectively). **Results:** (Table 1.) In the HAART era, hazard ratio of mortality is 0.658 for the entire population ($p < 0.01$). When assessed individually, the ESRD Networks 1, 4, 5, 7, 11 and 18 showed statistically significant lower hazard ratios for mortality (0.38–0.60) than the reference category (network 12). **Conclusion:** Regional differences exist in the rates of survival benefit from

HAART in patients with ESRD from HIVAN in USA. Further research may identify reasons for these differences which may include earlier adoption of HAART, better patient medication compliance or access to state-of-the-art HIV care and medications.

Table 1. Cox Multivariate Mortality Analysis in Patients with ESRD from HIVAN in the HAART era

	Sig.	Exp(B)
HAART	0.000	0.658
BMI	0.000	0.958
Albumin	0.000	0.730
Networks		
1: CT ME MA NH RI VT	0.034	0.593
2: NY	0.088	0.698
3: NJ PR Vis	0.293	0.797
4: DE PA	0.001	0.442
5: DC MD VI WV	0.020	0.604
6: NC SC GA	0.128	0.720
7: FL	0.003	0.517
8: AL MS TN	0.390	0.815
9: KY IN OH	0.228	0.737
10: IL	0.070	0.652
11: MI MN ND SD WI	0.001	0.381
12: IO KS MO NE	Ref	1
13: AR LA OK	0.231	0.730
14: TX	0.275	0.775
15: AZ CO NV NM UT WY	0.746	0.863
16: AK ID MT OR WA	0.193	0.495
17: AS HI NoCA PIs	0.342	0.765
18: SoCA	0.001	0.400

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Comparison of Treatment Results for PD Catheter Exit-Site Infections

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Purpose: In complications of peritoneal dialysis (PD) therapy, the peritonitis incidence rate has decreased year by year because of appearance of various interchange devices. On the other hand, the incidence rate of exit-site infections (ECI) has hardly changed. ECI are the main cause for cessation of PD in our country. In our hospital, as treatments for ECI, traditional skills such as cuff shaving, unroofing method (A group) used to be adopted. Then, an exit-site changing group using a titanium extender (catheter repair kit) (B group) and a catheter-exchanging group (C group) were performed. We report the comparison of each treatment groups. **Methods:** The A group includes 11 cases before February 1996, the B group: 26 cases to November 1998, and the C group: 38 cases to February 1999. Middle and long-terms results were examined for all groups. However, this is not a randomized study because each group's execution was different. The endpoint was set to be the time at which some surgical treatment was required. **Results:** Catheter-loss cases caused by exit-site infections because of the same bacterial infection were: 8 cases in the

A group (73%), 4 cases in the B group (15%), and 9 cases in the C group (24%). There was a significant difference between A and either B or C. Cases of catheter related infections included 9 A group cases, 13 B group cases, and 20 C group cases. Significant difference was found between A and C. In all over examination, it showed no significant differences among groups. **Conclusions:** B group have no postoperative leakage because they are not manipulated at the inner cuff. Therefore, usual PD becomes possible immediately after operation. This result suggested that treatment using titanium extender should be as good as exchange treatment. Therefore, we thought it valuable to examine it before extracting catheters.

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Microencapsulated Enzymes for Enteral Removal of Uremic Toxins

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Nature has developed elaborate biochemical pathways to recycle urea and other metabolic products of protein metabolism, first to ammonia and eventually to amino acids. These pathways are primarily resident in soil bacteria but are occasionally reported in mammals (e.g. hibernating bears). We report here a series of studies to see if these same reactions could be exploited to develop therapy formats as adjuncts to existing dialysis modalities for the treatment of end-stage renal disease. In an initial series of experiments, enzymes to degrade urea (jackbean urease), creatinine (flavobacterium creatininase) and uric acid (arthritis globormis uricase) were identified and dispersed in 500 micron alginatic microcapsules suitable for oral administration. In 24 hour in vitro experiments conducted at 37°C, ~5 ml of these capsules completely cleared 65% of the urea, 60% of the creatinine, and 100% of uric acid from ~100 ml of a challenge solution formulated to the concentration of these solutes in a presenting hemodialysis patient.

Metabolite	Quantity of enzyme (encapsulated in 5 ml of alginate)	Concentration (mg/dl)	
		0 h	24 h
urea	50 mg urease (800 units)	84	29
uric acid	0.6 mg uricase (10 units)	26	0
creatinine	0.4 mg creatininase (40 units)	10	4

Preliminary kinetic analysis confirms that a very manageable quantity of orally administered capsules would provide significant depurative effect in vivo.

Substance Transport in Albumin Dialysis

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Background: Albumin dialysis (MARS) aims to stabilize liver failure patients by supporting the liver's detoxification function. Toxin kinetics in this detoxification process in vitro and distribution processes in vivo are poorly understood. **Methods:** A) Bilirubin and Sulfobromophthalein (BSP) spiked plasma was dialysed (2 h) against albumin solution or water in a closed two-loop setup (MARSflux, TERAKLIN AG, Germany). Bilirubin, BSP and albumin levels were measured. Ultrafiltration = 0. B) 8 patients suffering from hyperbilirubinemia and hypoalbuminemia (decompensated ALD) received iv-albumin. Bilirubin and albumin levels were measured before and 24 h after administration. **Results:** A) Bilirubin and BSP concentration have not equilibrated, but was related to the molar ratio of either substance and albumin. The transport velocity could be correlated with the molar ratios/gradient ($R_2 > 0.95$). No transport in electrolyte dialysis. B) The iv-infusion led to increase of albumin concentration (27.4 to 32.4 g/L, $p < 0.01$). Simultaneously equimolar rise in bilirubin concentration (bilirubin: 91.1–109.5 $\mu\text{mol/L}$, $p < 0.01$; molar ratio: 0.22 to 0.22) was observed. **Discussion:** A) The results suggest that albumin bound substances are transported by a mechanism different from diffusion or equilibrium dialysis. Driving force is the gradient of described molar ratio. Process is describable by altered Fick's principle equation. B) Increase of intravascular carriers induces bilirubin shift. Use of bilirubin levels for assessing liver disease has to be reconsidered. **Conclusion:** Transports in albumin dialysis and unspecific transport in man might be similar. Bilirubin levels in hyperbilirubinemia are correlated with albumin levels.

Clinical Comparison of Synthetic High Flux Dialyzers in Convective Treatments: Albumin Loss vs. Removal of Uremic Solutes

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Purpose: Convective treatment modes are used to enhance the removal of uremic toxins in the higher molecular weight range, e.g. β_2 -microglobulin ($\beta_2\text{m}$). Dialyzer permeability should be well controlled to avoid possibly detrimental albumin loss especially under elevated transmembrane pressure (TMP) occurring in post-dilution hemodiafiltration (HDF). We investigated the permeability of two synthetic high flux dialyzers for albumin and $\beta_2\text{M}$ in post-dilution HDF mode. **Methods:** 6 patients were treated two times with online post-dilution HDF (AK200ULTRA; Qb 336 \pm 39 ml/min, Qd 500 ml/min, total UF-rate 110 \pm 15 ml/min, time 232 \pm 15 min) using Polyflux 170H (Gambro) and HF80S (Fresenius) dialyzers in randomized order. Solute removal was assessed from blood samples taken before and after treatment (reduction ratio: RR), as well as from mass transfer (Mt in mg/session) into total spent dialysate/ultrafiltrate collected by a splitting device. Urea and phosphate were analyzed by

photometric methods, $\beta_2\text{m}$ by heterogeneous sandwich magnetic separation assay, and albumin by nephelometry.

Results:

	Polyflux 170H		HF80S	
	RR [%]	Mt [mg]	RR [%]	Mt [mg]
urea	72 \pm 5	48 \pm 16	71 \pm 5	42 \pm 19
phos	49 \pm 9	1,107 \pm 229	49 \pm 12	1,004 \pm 23
$\beta_2\text{m}$	77 \pm 4	178 \pm 49	78 \pm 4	180 \pm 44
alb	–	2,474 \pm 3,521	–	3,781 \pm 3,164

Ratio between $\beta_2\text{M}$ (mg) and albumin (g) in dialysate-ultrafiltrate was significantly larger for P170H (143 \pm 103) than for HF80S (103 \pm 111, $p < 0.0017$). Albumin loss significantly correlated (P170H: $p < 0.01$; HF80S: $p < 0.0001$) with TMP increase during treatment, but the influence of TMP was significantly different: 2.3 g alb/100 mmHg TMP increase for HF80S and 0.6 g alb/100 mmHg TMP increase for P170H ($p < 0.0001$). **Conclusions:** The two dialyzers allowed comparable reduction of uremic solute levels, but mass transfer of urea and phosphate tended to be larger and albumin loss lower for P170H. The lesser loss of albumin found for P170H at similar $\beta_2\text{m}$ mass removed indicates that its three-layer structured membrane better withstands high TMP during postdilution HDF than the sponge like membrane structure of HF80S. This property may be valuable in optimizing convective therapies.

Continuous Flow PD (CFPD) as Primary Renal Replacement Therapy (RRT) in a Patient with Hemodialysis Access Failure

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CFPD is a technique of RRT first used in the 60s by Shinaberger. It involves the recirculation by pump of peritoneal dialysate through an external purification loop. This maintains a constantly high transperitoneal solute gradient, which maximizes solute transport. We used this technique in a patient with failed hemodialysis access who was unsuitable for home PD. **Methods:** The patient is a 46 year old Hispanic male with ESRD from heroin nephropathy. He started hemodialysis in 1989, had a short course of CAPD in 1990 which promptly failed due to peritonitis. He returned to HD and over the years exhausted AV access and venous sites, with the exception of the right femoral vein. He had many other complications including endocarditis, requiring aortic valve replacement, and secondary hyperparathyroidism requiring parathyroidectomy. Two peritoneal catheters were implanted – one with the curled tip in the pelvis, the other with the curled tip in the left upper quadrant. At each procedure, a y-set is attached to one catheter and a variable amount of ascites is drained. 2 liters of fresh PD solution, 1.5 or 2.5% dextrose is then infused. The catheters are attached to standard dialysis tubing and a Fresenius Opti 160 or 180 hemofilter. Peritoneal solution is pumped

through the circuit at 250–300 ml/min. The hemofilter is bathed in dialysate with zero K, 2.5 mEq/l Ca at 500 ml/min. Treatment time varied from 3 to 6 hours, depending on the patient's schedule. 4 or 5 treatments were done per week. **Results:** Mean values based on pre/post blood chemistries over the first 4 weeks are as follows:

Time (min)	Wt. loss (kg)	URR (%)	PhosRR (%)	CreatRR (%)	Kt/V	Ku (ml/min)
294	1.55	13.6	14	10	0.21	25.1

Due to time constraints and low weekly kt/V, we replaced one session weekly with a hemodialysis via temporary femoral catheter. The treatments are ongoing as of this writing.

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Application of Proteomic Techniques to the Identification of Proteins Retained in Uremia

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Introduction: The nature of uremic toxins is incompletely defined and investigations are usually limited to solutes for which specific analytical methods are available. This approach does not allow identification of novel solutes and may not yield information on solutes whose toxicity arises from their modification in the uremic milieu. We used proteomic techniques to characterize solutes retained in uremia in the molecular weight range 10 to 70 kD. **Methods:** Ultrafiltrate was obtained from hemodialysis patients treated with high-flux dialyzers using isolated ultrafiltration. An ultrafiltrate of normal plasma served as a control. Ultrafiltrate was concentrated 50-fold using a 3 kD cut-off membrane and 150 µg of protein submitted to isoelectric focusing on an immobilized pH gradient (IPG) strip (pH 3–10). The IPG strip was loaded onto a 22 cm × 22 cm 15% duracryl gel and electrophoresis performed. The resulting two-dimensional gel was stained with SYPRO ruby to visualize proteins, which were excised from the gel, digested with trypsin, and the peptides submitted to MALDI-TOF mass spectrometry followed by peptide mass fingerprinting. **Results:** Gels of ultrafiltrate from hemodialysis patients showed more than 300 proteins in the molecular weight range 10 to 70 kD, with significant differences in the molecular weight distribution obtained with different high-flux dialyzers. The pattern and relative abundance of proteins was also markedly different from that obtained from a filtrate of normal plasma. A total of 20 protein forms of 12 unique proteins have been identified. The presence of multiple forms of some proteins has been confirmed for complement factor D by immunoblot analysis of the two-dimensional gel. Based on molecular weight shifts, glycosylation is predicted to explain some of the multiple forms of the same protein. **Conclusion:** These studies demonstrate that uremia is characterized by the retention of a large number of small proteins, many of which may be present in multiple forms.

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Impact of High Flux Hemodialysis Using a Synthetic Membrane on Middle Molecule Levels and Markers of Cardiovascular Risk: Results of a Prospective Cross Over Study

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Purpose: Cardiovascular complications are the major cause of death in hemodialysis patients. Limitation of chronic inflammatory processes as well as control of lipid metabolism are potential measures to avoid or delay the onset of clinical signs of atherosclerosis. The clinical relevance of using biocompatible high flux dialyzers with respect to these complications is a matter of debate. We investigated the influence of using biocompatible high flux dialyzers on clinical parameters related to inflammation and lipid metabolism. **Methods:** After a run-in period of 1 month, 59 chronic HD patients were switched from conventional cellulosic dialyzers to biocompatible high flux dialyzers (Polyflux S) and prospectively followed for 6 months. Pre-dialysis blood samples were taken 1 month before and at time of change of dialyzer, as well as 2, 4 and 6 months after. Samples were analyzed for β₂-microglobulin (β₂M, ELISA), as a middle molecule uremic toxin, and C-reactive protein (CRP, ELISA) as well as lipid status (cholesterol, triglycerides, HDL and LDL) as risk factors for cardiovascular complications. Results of the 43 patients who completed the observation period are presented in the table below.

Results:

Month	0	1	3	5	7
Dialyzer	cell	cell	POF S	POF S	POF S
β ₂ M [mg/l]	35 ± 14	33 ± 11	24 ± 8*	23 ± 6*	23 ± 7*
CRP [mg/l]	18 ± 28	15 ± 22	18 ± 22	17 ± 26	15 ± 23
HDL [mg/dl]	40 ± 14	40 ± 14	40 ± 16	42 ± 17*	44 ± 18*
LDL [mg/dl]	86 ± 33	83 ± 35	81 ± 30	75 ± 24	68 ± 26*
HDL/LDL [%]	57 ± 44	66 ± 77	62 ± 67	68 ± 56	81 ± 60*

*p < 0.05 vs. time 0 and 1 month, paired t-test, 2 sided.

β₂M levels significantly declined, while CRP remained constant during the study period. Lipid profile improved significantly, while the proportion of patients receiving lipid lowering medication was not different for the two study periods (month 0 to 1: 42% vs. month 3 to 7: 43%). **Conclusions:** High flux hemodialysis using biocompatible dialyzers leads to a significant decline in plasma concentration of β₂M and improvements in lipid profile. Whether this may help to reduce the need for lipid lowering medication has to be confirmed by larger prospective controlled studies.

Bacteremia Associated with Tunneled, Cuffed Hemodialysis Catheters (TCC): Wide Disparity in Nephrologist's Practices and Suboptimal Therapeutic Management

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Background: When TCC salvage is attempted (antibiotic administration without TCC removal) the treatment failure rate is high (~66%), compared to wire exchange or removal with delayed reinsertion (each ~18%). Despite these published data, nephrologists continue to implement TCC salvage. **Purpose:** To determine management of TCC bacteremia at our centers we performed a 2 year, prospective multicentered study in chronic HD patients dialyzing with a TCC at 7 HD units (5 Bronx, 2 Hartford). The patient's nephrologist determined clinical management. **Results:** There were 120 episodes of TCC bacteremia, (74 Bronx, 46 Hartford). TCC salvage was implemented in 25% of episodes, however this varied significantly between individual hemodialysis units, (range of 0 to 55%, $p = 0.036$). There was no difference in TCC salvage use between the Bronx (27%) and Hartford (22%) units, when combined geographically, $p = 0.5$. The practice patterns of 16 nephrologists were observed: (9 Bronx, 7 Hartford), (11 academic/hospital based, 5 private practice). There were marked differences in individual nephrologist practice with regard to TCC salvage use, (range 0–50%), $p = 0.132$. TCC salvage was attempted in only 6% of episodes in which a gram negative was isolated, compared to 25% cases of *Staph. aureus*, and 38% another gram positive, $p = 0.004$. TCC salvage rate was not associated with nephrologist practice type, race, exit site appearance, age, temperature, white blood count, HIV or hepatitis status. The isolate was insensitive to the empiric and subsequent antibiotic selection in 15% and 18% of episodes, respectively. Inappropriate antibiotic dosing was observed in 10% of episodes. Vancomycin and other aminoglycosides were continued inappropriately in 14% and 10% of episodes. **Conclusion:** There is marked variability in the management of TCC associated bacteremia. TCC salvage continues to be implemented in a large number of patients despite poor outcome associated with this strategy. Antibiotic selection/use is inappropriate in an unacceptably high percentage of cases.

Increased Incidence of Hemodialysis Catheter Infections with Intravenous Iron Administration

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Introduction: Intravenous iron (Fe) use in dialysis patients has been linked to infections. The purpose of this study was to determine

if IV Fe administration increased the incidence of hemodialysis catheter infections. **Methods:** Records of patients undergoing maintenance hemodialysis at the UConn/DCI dialysis center from January 2000 to December 2001 were reviewed. Data collected included months with catheter infections, as well as concurrent ferritin levels and culture results. Analysis was done using a two-table Chi-square test. **Results:** There were 38 patients with hemodialysis catheters and a total of 264 patient catheter-months. IV Fe, as Fe sucrose or Fe gluconate, was loaded during 80 catheter-months. During the 80 catheter-months with IV Fe, there were 13 episodes of catheter infections (16.25%). In contrast, during the 184 catheter-months without IV Fe, there were 10 episodes of catheter infections (5.4%). The incidence of catheter infections occurring within the month of IV Fe administration was found to be significantly higher than the incidence of catheter infections during months when IV Fe was not given ($p < 0.01$, Chi-square = 8.2). During the months with catheter infections, the patients' ferritin levels ranged from 82 to 1,531 mcg/L, with only three above 800. Catheter tip and blood cultures had grown varying organisms including cutaneous flora, *Staph. aureus* and Gram-negative rods. **Conclusions:** These results suggest that IV Fe is a risk factor in hemodialysis catheter infections. Timing, dose and ultimate safety of IV Fe in catheter-dependent hemodialysis patients need further study.

Effect of Continuous Hemofiltration on Severe Burned Patients – A Case Series in Vietnam

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Introduction: Organ dysfunction is one of the severe complications for severe burned patients. The mortality rate and the treatment of this complication are still challenging. **Purpose:** This prospective study investigated the effect of CVVH on severe burned patients admitted to Burn ICU Hanoi National institute of burns from 8/2001–4/2002. **Methods:** 71 patients with OD (organ dysfunction) were divided into two groups (Hemofiltrated and non-Hemofiltrated group). **Results:** The results showed that: after Hemofiltration the plasma concentration of pro-inflammatory cytokines including IL2, IL6, IL8 and TNF significantly decreased ($p < 0.01$). In addition the mortality rate was 38.71%, much lower than the control group (87.50%).

The Cause of Unexplained Troponin T Elevations in Patients with Severe Renal Failure

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Introduction: Cardiac specific troponin T (cTnT) is used as a marker to assess myocardial tissue damage. Earlier studies showed elevated serum cTnT levels in patients with severe renal failure without clinical symptoms of myocardial ischemia. Several mechanisms have been proposed, including cross-reactivity with skeletal TnT, which does not appear to account for the current 3rd generation assay, and a decreased renal clearance of TnT fragments. However, the mechanism behind the increase of cTnT in asymptomatic renal patients remains unknown. We investigated the hypothesis of TnT fragmentation and subsequent decreased renal clearance, contributing to an increase of cTnT towards measurable levels. **Methods:** Serum cTnT and CK-MB mass were measured in 63 hemodialysis patients. Immunoprecipitation, using immobilized anti-TnT antibodies was used to isolate TnT and its possible fragments from serum. These fragments were separated subsequently by gel-electrophoresis and visualized by Western blotting and chemoluminescent detection. This method was applied to serum samples of 21 dialysis patients in whom cTnT concentrations varied from <0.01 to 0.4 g/L. **Results:** Fifty-five out of the 63 patients had measurable cs-TnT levels, although myocardial ischemia was unlikely because of normal CK-MB mass concentrations (n = 56). All 21 sera investigated for fragmentation contained TnT fragments ranging in size from 8 to 25 kDa whereas no fragments were found in pooled cTnT negative serum from healthy volunteers. No differences in fragmentation patterns were found between the individual patients, suggesting a universal fragmentation mechanism. **Conclusion:** cTnT, released by a normal loss of cardiomyocytes, is fragmented and cleared from the circulation by properly functioning kidneys. In hemodialysis patients, fragments of TnT accumulate in the circulation, which might explain the increase in serum cTnT levels in absence of myocardial ischemia.

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Blood Flow Rate Effects in High-Dose Pre-Dilution CVVH

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Introduction: Since the dose range recently shown to favorably influence outcome in patients treated with continuous veno-venous hemofiltration (CVVH) (Ronco et al., Lancet 2000) is very difficult

to deliver in the post-dilution mode, the pre-dilution (PRE) mode is typically prescribed for high-dose therapy. However, the relatively low blood flow rate (Q_b) values that have been traditionally prescribed in CVVH may severely limit the ability to deliver such therapy (Trojanov et al., NDT 2003). **Methods:** In an experimental isovolemic PRE CVVH system employing substitution fluid rates (Q_s) of 2 and 4 L/h, we determined the effect of variable Q_b (150 vs. 250 mL/min; bovine blood, hematocrit, 0.30) on urea (U) and creatinine (C) clearance by a 1.2 m² polysulfone hemofilter. Clearances (K) were determined from filtrate-side measurements as K = mass removal rate/C_b. C_b was sampled both before the PRE port to provide a treatment clearance (K_t) and after the PRE port to provide a filter clearance (K_f), the latter being equal to the clearance achieved in post-dilution under the same conditions. The results are (mean ± SD; N = 3 for each Q_b/Q_s combination):

Results:

	Q _s = 2 L/h		Q _s = 4 L/h	
	K _t (mL/min)	K _f (mL/min)	K _t (mL/min)	K _f (mL/min)
Urea				
Q _b = 150	27.6 ± 1.0	33.1 ± 1.3	47.4 ± 1.2	67.5 ± 2.3
Q _b = 250	28.7 ± 0.4	33.0 ± 0.8	55.0 ± 2.2	68.7 ± 1.5
Creatinine				
Q _b = 150	27.1 ± 0.9	34.5 ± 1.3	45.4 ± 0.6	70.5 ± 0.9
Q _b = 250	29.5 ± 0.7	34.5 ± 0.4	53.9 ± 1.7	70.6 ± 2.9

For both Q_s conditions, both U and C clearances (K_t) significantly increased when Q_b increased (p < 0.05), indicating an attenuating effect on dilution. The Q_b effect was especially pronounced at Q_s = 4 L/h, with solute clearances increasing 16–19% on a mean basis. Even at the higher Q_b value, however, K_t values for U expressed in mL/h/kg for a 70 kg patient were 24.6 and 47.1 mL/h/kg, respectively, at Q_s = 2 and 4 L/h, with post-dilution (K_f) reference values of 28.3 and 58.9 mL/h/kg. **Conclusion:** Delivery of high-dose CVVH is enhanced by use of Q_b values significantly higher than those traditionally employed.

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Quantitative Hepatitis C Antibody Assay and HCV Infection Testing Algorithm in Hemodialysis Patients

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Introduction: Seroconversion of HCV-antibody in hemodialysis patients was 3.6%/year in Japan (Braggs JASN 2000;11:A258). For the adaptation of the isolation precaution to HCV-infected patients, we compared the value of quantitative HCV-antibody assay with RT-PCR assay for HCV-RNA in hemodialysis patients. **Methods:** Study was done in six dialysis centers: two hospital-based dialysis units and four

outpatient clinics. All 1,077 hemodialysis patients agreed to the measurements of their serum transaminase activity, HCV-antibody (Lumipulse, FUJIREBIO Inc.), HCV-antigen, and qualitative and/or quantitative RT-PCR assays for HCV-RNA. **Results:** The results showed that 926 patients (85.3%) showed HCV-antibody and HCV-antigen negative (not infected), 33 patients (3.1%) were HCV-antibody positive and HCV-antigen negative (infected and cured), no patients were HCV-antibody negative and HCV-antigen positive (supposedly new infection), and 116 patients (10.8%) were HCV-antibody and HCV-antigen positive (continuously infected). To reduce the cost for expensive RT-PCR assays, we introduced HCV infection testing algorithm for elderly (Yoshizawa H, 2002) to dialysis patients. This algorithm assumes that patients with HCV antibody titer >80 would be HCV-RNA positive and patients with HCV-antibody <1 would be HCV-RNA negative. The remaining groups were estimated by qualitative and/or quantitative RT-PCR assays for HCV-RNA. This algorithm reduced 58.9% of the measurements of RT-PCR assay, and the results completely matched with the reports of full HCV-RNA assays. **Conclusions:** We conclude that HCV-antibody assay and this algorithm are reliable methods for the detection HCV-infected dialysis patients.

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The Influence of Physical Training on Exercise Capacity, Muscle Strength and Body Composition in Renal Transplant and Hemodialysis Patients

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Introduction: Physical performance is often impaired in hemodialysis (HD) and renal transplant (RTx) patients. Moreover, in RTx patients, a decreased physical activity level was found to be related to a decreased lean body mass (LBM). In this study, the influence of intensive, supervised physical training on exercise capacity, muscle strength and body composition was assessed in RTx and HD patients and healthy, inactive controls (CTS). **Methods:** Sixteen RTx patients using 5–10 mg steroids (ST+, 9M/7F), 17 RTx patients on steroid-free immunosuppression (ST-, 9M/8F), 14 HD patients (9M/5F) and 18 CTS (9M/9F) completed a 12-week lasting training program (2 sessions each of 2 h/week). Maximum exercise capacity (W_{max} ; cycle-ergometry), strength of several muscle groups (a.o. biceps and quadriceps femoris; P_{max}) and body composition (DEXA) were measured before and after the training-intervention period. The standardized, gradually increasing training program (finally 75% of W_{max} and 60% of P_{max}) was based on W_{max} and P_{max} tests performed at baseline. At baseline, groups were comparable for age, body weight, LBM and P_{max} of the biceps and quadriceps femoris; RTx-groups were also comparable for creatinine clearance; W_{max} of the HD patients was, however, significantly lower than W_{max} in the ST+, ST- and CTS group. **Results:** After 12 weeks of training, W_{max} equally increased significantly in ST+ (17.9%), ST- (23.7%), HD (24.8%) and CTS (17.8%) (all $p < 0.05$).

Moreover, P_{max} of the biceps and the quadriceps femoris significantly increased to the same degree in ST+ (19.3 and 27.9%), ST- (27.5 and 17.0%), HD (23.9 and 26.3%) and CTS (19.9 and 23.1%) (all $p < 0.05$). In contrast to CTS, in whom LBM significantly increased after training (1.3 ± 1.5 kg, $p < 0.05$), LBM did not change in ST+, ST- and HD patients. **Conclusions:** In conclusion, intensive physical training leads to a major increase of W_{max} and muscle strength in all groups of renal patients and in CTS. Strikingly, physical training did not increase LBM in renal patients; this in contrast to CTS, in whom LBM increased significantly.

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Percutaneous Native Renal Biopsy: 'How Many Passes'?

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Background: In an effort to obtain adequate tissue for diagnosis during percutaneous renal biopsies, more than one needle insertion into the kidney ('pass') is frequently done to obtain higher numbers of glomeruli. Some clinicians limit number of passes due to a perception of increased risk of complications with increasing number of passes. **Objective:** To assess for any association between tissue yield (number of glomeruli) and complications in real-time ultrasound guided percutaneous renal biopsies. **Design:** Observational Cohort study. **Methods:** Review of all percutaneous native renal biopsies ($n = 36$) was done to identify total glomerular count as reported by pathology over study period (Jan 1–Nov 15, 2002). All biopsies were done using real-time ultrasonography guidance with 18-gauge needles. Complications were graded by severity from 0–4 (see table 1). **Results:** (Table 1) Glomerular count ranged widely from 0 to 39 with a mean of 16 (SEM 1.8) and complication scores are as tabulated. Spearman's rho correlation coefficient (one-tailed) between glomerular count and complication score was -0.009 ($p = 0.48$). There was also no significant correlation between glomerular count and complication score 4 only (0.081, $p = 0.32$).

Table 1. Complication scores in 36 native renal biopsies

Complication score	Frequency	Percent	Cumulative percent
0	20	55.6	55.6
1	2	5.6	61.1
2	4	11.1	72.2
3	6	16.7	88.9
4	4	11.1	100.0
Total	36	100.0	

0 = none, 1 = pain requiring additional or narcotic therapy, 2 = gross hematuria only, 3 = hematuria or hematoma and drop in hematocrit <3% with passive intervention only (observation, intravenous fluids), 4 = hematuria or hematoma requiring active intervention (blood transfusion, additional hospitalization or surgical/radiological procedure). **Conclusion:** Increased glomerular yield

showed no correlation with complications in general or severe complications (score 4) in particular. With the use of real-time ultrasound guidance, limiting the number of passes to decrease complication risk is not justified and may predispose to inadequate samples (low glomerular yield).

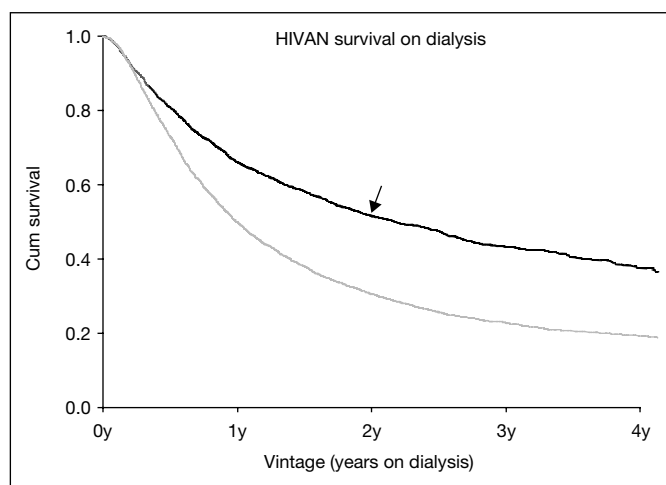
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Emerging Trends in Survival of ESRD Patients with HIV/AIDS Associated Nephropathy in USA

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Historically, high mortality rates were common in patients treated for ESRD from HIV/AIDS associated nephropathy (HIVAN). Highly active antiretroviral therapy (HAART) was introduced to the general population of HIV/AIDS patients in 1996 and mortality rates from HIV/AIDS have since declined. **Objective:** To evaluate the impact of HAART on mortality rates in ESRD patients from HIVAN in USA. **Methods:** Analysis was done on prospectively collected data from the ESRD medical evidence report medicare entitlement and/or patient registration forms (HCFA-2728) and death notification forms as archived in the standard analysis files of the United States renal data systems (USRDS) core CD for all ESRD patients (n = 1,090,121) in the USA up to May 2000. All patients with primary cause of ESRD reported as HIVAN were identified (n = 6,179) and patients with duplicate data entries or who received a transplanted kidney were excluded from the analysis (n = 6,158). Survival on dialysis was compared among two groups: Pre-HAART era (n = 3,001) and HAART era (n = 3,157) i.e. patients with date of first dialysis before and after 1/1/96 respectively. Kaplan-Meier survival plot for patients with ESRD from HIVAN in Pre-HAART era and HARTT era (arrow). **Results:** (Figure) The median survival time for pre-HAART group is 0.99 year (± 0.03) compared to 2.18 year (± 0.10) in HAART group ($p < 0.01$). **Conclusion:** There is an established significant trend of improving survival of ESRD patients from HIVAN in the HARTT era.



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Endotoxin Permeability of High-Flux Hemodialysis Membranes Fabricated from Different Polymers

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Purpose: This study compared the endotoxin (Etx) transfer from contaminated dialysate across high-flux hemodialysis (HD) membranes made from different polymers into the blood compartment with saline present in both, the dialysis and blood compartments.

Methods: In vitro dialysis experimentation. I. Comparison of DIAPES HF800 (Polyethersulfone), Polyamide S (Polyethersulfone) and Helixone (Polysulfone). After a pyrogen-free phase (15 min), the dialysate compartment was contaminated with Etx (sterile filtrates from *Pa. aeruginosa*, 20 EU/ml), recirculation was carried out at QB = 200, QD = 500 ml/min for 60 min, followed by a 60 min filtration phase (QD = 500 ml/min, QF = 15 ml/min). Etx was quantified in samples from the blood compartment with a kinetic-chromogenic LAL test (coatest, detection limit 0.005 EU/ml in saline solution). II. Polyamide S (Polyethersulfone), AN69ST (Polyacrylonitrile), α -Polysulfone (Polysulfone) and Helixone (Polysulfone) were compared. Experimental conditions were as described, except Etx challenge was 50 EU/ml. Etx adsorption to the membranes was calculated as the difference between the levels of the initial challenge and that after 120 min. **Results I:** A significant transfer of Etx was observed for DIAPES and Polyamide S, while the values for Helixone were only slightly above the detection threshold. **Results II:** (Table) Helixone exhibited the highest Etx adsorption capacity, while α -Polysulfone, Polyamide S and AN69ST showed only 60%, 29% and 4% Etx adsorption, respectively, as compared to Helixone. **Conclusions:** In a blood-saline model penetration of pyrogens is attenuated by the adsorbed protein layer (Lonnemann et al., NDT 1995;10:207-211). Thus, a saline-saline model was used in this study to reflect the priming phase of dialysis. Under these conditions, DIAPES (Schindler et al., Clin Nephrol 2003;59:447-454), Polyamide S and AN69ST were insufficient barriers to endotoxin. Moreover, α -Polysulfone exhibited a lower endotoxin adsorption than Helixone despite being made from the same polymer. Thus, the overall conditions of membrane fabrication, rather than the polymer alone, determine the Etx permeability profiles of HD membranes.

Table to abstract 52

Membrane name	Polymer name	Dialyser type	Endotoxin adsorption (EU/dialyser)	Endotoxin adsorption (EU/cm ² membrane)
Polyamide S	Polyethersulfone	Polyflux, 140H 1.4 m ²	13,693 ± 2,400	0.98 ± 0.17
AN69 ST	Polyacrylonitrile	Nephral ST 400 1.65 m ²	1,959 ± 92	0.11 ± 0.03
Helixone	Polysulfone	FX 60 1.4 m ²	45,984 ± 7,870	3.28 ± 0.56
α-Polysulfone	Polysulfone	Diacap HI PS18 1.8 m ²	27,736 ± 8,607	1.54 ± 0.48

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Phosphate Kinetics During Alternative Hemodialysis Treatment Regimens

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Introduction: Phosphate is a well known uremic toxin, but phosphate kinetics during hemodialysis (HD) treatments are only partially understood. We simulated phosphate kinetics during more intensive HD treatment regimens using the four-pool mathematical model recently reported by Spalding et al., (Kidney Int 2002;61: 266–275). **Methods:** Steady state kinetic profiles were computed for a 70 kg patient during conventional thrice weekly HD (CHD; 4 hrs/treatment), long thrice weekly HD (LHD; 8 hrs/treatment), short daily (6 times per week) HD (SDHD; 2 hrs/treatment) and nocturnal daily (6 times per week) HD (NDHD; 8 hrs/treatment). Blood and dialysate flow rates (ml/min) were assumed as 370/500 for CHD and LHD, 370/800 for SDHD and 250/100 for NDHD. High flux dialyzer clearance of phosphate was assumed to be 90% of that for urea, and protein intake was assumed to be 80 g/day. Fluid intake (1 L/day) was assumed to accumulate in and be removed from the extracellular space, and residual renal function was neglected. Calculated average pre-treatment serum phosphate concentrations (P) were compared with urea stdKt/V as defined by Gotch and average pre-treatment serum beta-2-microglobulin concentrations (β_2M) calculated using a two-pool model as reported previously (Goldfarb-Rumyantzev et al., AJKD 2002;40:1211–1218):

Results:

Parameter	CHD	LHD	SDHD	NDHD
stdKt/V (1/wk)	2.40	3.26	3.26	4.77
β_2M (mg/L)	40.3	34.7	38.1	28.9
P (mg/dL)	5.76	5.39	4.60	4.20

Conclusions: These simulations show that long HD treatments are more effective at lowering predialysis concentrations of beta-2-microglobulin, whereas more frequent treatment regimens are more effective at lowering predialysis concentrations of phosphate.

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On-Line Hemofiltration versus Hemodialysis at Different Dialysate Temperatures – A Short-Term Hemodynamic Study

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Background: An important advantage of convective therapies is a reduction in intra-dialytic hypotension. However, it is not well known whether convective therapies are superior in this aspect compared to hemodialysis with an adjusted temperature of the dialysate. **Methods:** In the present study, we assessed the hemodynamic response during on-line hemofiltration (HF) and hemodialysis (HD) with two different temperatures of the dialysate (36.5°C and 35.5°C) in 11 stable patients, using the saline dilution technique (Transonic®). Hemofiltration was performed with pre-dilution infusate temperature 36.5°C, infusate volume: 1.2 × body weight. Cardiac output (CO; liter), central blood volume (CBV; liter) and peripheral vascular resistance (PVR; mmHg/ml/min) (*p < 0.05 pre versus post) were recorded. Ultrafiltration volume was equal (2.4 ± 1.0 l) between all treatments.

Results:

		On-line HF	HD 36.5°C	HD 35.5°C
CO	pre	6.3 ± 2.4*	6.5 ± 1.0	6.3 ± 1.2*
	post	5.5 ± 2.1	6.1 ± 1.2	5.6 ± 1.0
PVR	pre	13.9 ± 5.5	14.7 ± 2.0	16.9 ± 5.2
	post	15.0 ± 6.1	15.4 ± 2.0	17.5 ± 4.1
CBV	pre	1.31 ± 0.53*	1.38 ± 0.32*	1.31 ± 0.31
	post	1.15 ± 0.45	1.28 ± 0.29	1.29 ± 0.31

Body temperature remained stable during HF and HD 35.5°C (+0.1 ± 0.6 and -0.1 ± 0.3°C) and increased slightly but not significantly during HD 36.5°C (+0.3 ± 0.6°C). Pooling all treatments, multiregression analysis showed that the change (Δ) in CO was a significant predictor for Δ PVR ($r = -0.53$; $t = -3.5$; $p < 0.001$), whereas the treatment modality was not ($t = -0.6$). Δ CO was strongly and independently related to Δ CBV ($r = 0.60$; $t = 3.2$; $p < 0.001$) and inversely to the ultrafiltration rate ($r = -0.67$; $t = -4.2$; $p < 0.001$). **Conclusion:** Using the saline dilution technique, no difference in Δ PVR was observed between on-line hemofiltration and hemodialysis with dialysate temperatures of 36.5 or 35.5°C. In contrast, Δ PVR was strongly and inversely related to

Δ CO, which was in turn related to ultrafiltration rate and Δ CBV. Thus, in the absence of significant changes in body temperature, the intra-dialytic hemodynamic response appears more dependent upon the degree of fluid removal than upon the treatment modality.

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Improvement of Residual Renal Function (RRF) in Diabetic Peritoneal Dialysis (PD) Patients With the Use of Biocompatible PD Fluid: Report of 3 Cases

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Introduction: RRF in PD is an independent predictor of technique and patient outcome with significant impact on e.g. blood pressure control, LVH, infection susceptibility, over-hydration, nutrition, and survival. RRF decline is correlated to parameters of oxidative and carbonyl stress, known to induce tissue damage e.g. via accelerated formation of advanced glycation end products. This led us to the idea that uptake of carbonyl stress components, i.e. glucose degradation products (GDP) in PD fluids, at compromised carbonyl stress elimination might affect RRF. PD fluids in newly developed multi-compartment bags contain strongly reduced amounts of GDP compared to conventional fluids. **Results:** We report here examples of RRF changes in 3 ESRD patients being new on PD therapy. All subjects are insulin-dependent diabetics. They started PD using fluid with minimized GDP concentration (Gambrosol trio, Gambro Co.) compared to conventional fluids (e.g. 3-deoxyglucosone <30 vs. >350 μ M at 1.5% glucose). RRF was assessed every 4 weeks as mean of urea and creatinine clearance. After PD start, a substantial increase in RRF (mL/min) was observed:

	RRF at PD start	RRF after PD start	Medication
Case 1	8	13.4*	ACE-I
Case 2	12.5	21.5**	Statin
Case 3	16	19*	ACE-I, ARB

*after 5 months, **after 4 months.

Conclusions: As medication was not changed at PD start, we strongly suggest that improvement of RRF be attributed to the use of biocompatible fluid, positively affecting pathways of tissue damage. We are well aware of the multiple confounding factors influencing RRF time course in terminal kidney disease. However, these case observations are clinically remarkable and may put forward the hypothesis that carbonyl compounds are an important factor involved in damage of renal tissue.

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Tunneled Cuffed Hemodialysis Catheter (TCC) Bacteremia with Pseudomonas (P): Risk Factors and Outcomes

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Introduction and Methods: We performed a prospective observational study in 6 dialysis units. All patients who were diagnosed as having their initial TCC associated bacteremia during the study period (presence of positive blood cultures and without evidence of another source of bacteremia) were followed for 3 months. The monthly laboratory data preceding the bacteremic episode and clinical demographic information were recorded. **Results:** In the 2.5 year study period, 233 episodes of TCC bacteremia were identified, 18 were with a P isolate, (8%). The P infected group was similar to the non-pseudomonas (NP) population with regard to race, sex, diabetes, rate of hospitalization, viral infection, and prior bacteremia within 3 months. In comparison to NP, episodes with P were associated with a 3.6 fold higher risk of not receiving appropriate initial antibiotics (95% CI:1.2–11.1, $p = 0.02$) and were more likely to be associated with multiple isolates (P 28% vs. NP 12%, $p = 0.06$). TCC management was more conservative in the P group, with TCC removal and delayed reinsertion occurring in 50% of episodes (vs. NP 41%), whereas TCC salvage was attempted in only 11% (vs. NP 23%), ($p = ns$). The outcomes of recurrent bacteremia (same or different organism), death, and complications were similar with regard to isolate. The combined outcome of recurrent bacteremia and death was similar between groups, (P = 28%, NP = 25%, $p = ns$). In a multi-variate analysis controlling for P, diabetes, age, TCC management and appropriate initial antibiotics, only TCC salvage was associated with the combined outcome, (RR = 2.1, $p = 0.04$). In a separate analysis including only P isolates ($n = 18$) the mode of TCC management was not associated with the combined outcome. **Conclusions:** Although P accounts for a small percent of isolates, initial antibiotics should include anti-P coverage. P is not associated with worse outcomes. Guide-wire exchange is a safe alternative to TCC removal with delayed reinsertion in P bacteremia.