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Access

Native Distal Cimino-Brescia Arteriovenous Fistula Survival in Diabetic and Nondiabetic Patients

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Purpose: The goal of this stud was evaluate the survival of the distal native Brescia-Cimino arteriovenous fistula (AVF) at the wrist in 2 groups consisting of diabetic patients in one, and nondiabetic patients in the other. ***Methods:*** In the period lasting from June 30, 2004 to June 30, 2010 we performed 245 native AVF at the wrist or distal forearm in patients with end-stage renal failure (ESRF) before starting dialysis. Forty-six patients were insulin dependent and 199 were not diabetic but they had come to ESRF for other nephropathies. The mean age in the diabetic group was 62.4 ± 15.6 years and 14 of the 46 were female, whereas in the nondiabetic group, the mean age was 63.8 ± 17.3 years and 61 of 199 were female. The end-to-side anastomosis was used in 52.2% of diabetic and in 50.3% of no diabetic patients without any significant difference. In other patients we performed a end-to-end anastomosis. The preoperative evaluation was done by the same nephrologists who took care to create an AVF in the operating room located inside the dialysis center. Patients with suitable vessel (diameter not less than 2–2.5 mm for the artery and vein, respectively) were chosen. The average time to first dialysis treatment after operation was 2.38 ± 1.83 months in diabetic and 2.19 ± 1.79 months in nondiabetic group. The statistical study was performed by comparing averages and between the Student *t*-test and the chi-square test. ***Results:*** The median survival of distal AVF was 21.59 ± 20.85 months in diabetic patients and 27.48 ± 22.51 months in patients without diabetes. This difference was significant to the Student *t*-test ($P=0.05$). Examining the AVF survival curves in both groups of patients, we found that the primary patency 1 year rate was 56.1% in diabetic patients and 73.1% in nondiabetics with $P=0.025$ to the chi-square test. Over time, the survival of AVF in patients without diabetes was not statistically significant. ***Conclusions:*** The study we have conducted on distal native AVF in patients who have to start dialysis treatment, leads us to conclude that diabetic patients could not be considered for a distal native AVF because a primary patency 1 year rate significantly reduced compared with nondiabetic patients. But, the policy of vascular savings and the chance of reusing arterialized veins after failing of the primary AVF, may suggest preparing a distal AVF also in diabetic patients. In any case, it is in the experience and wisdom of those who deal with these issues, to decide whether to prepare, for starting dialysis, a distal AVF in patients with compromised vessels such as those found in diabetics.

Buttonhole Tunnel Preparation: 16 or 15 G Sharp Needles?

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Background: A well-functioning vascular access was crucial in clinical management of patients on dialysis. The cannulation of arteriovenous fistula (AVF) by means of the buttonhole method offers several advantages: Low incidence of complications of AVF, easier cannulation by staff, less perception or absence of the pain by the patient at moment of cannulation. ***Purpose:*** We know that the success of the buttonhole technique is related to the proper preparation of the subcutaneous tunnel. This is done by means of sharp needles for a period lasting from 6 to 8 sessions of dialysis. The K-DOQI guidelines do not specify the size of needles to use. In our experience, we evaluated the success rate of the buttonhole technique with sharp needles 16 vs. 15 G. ***Methods:*** We have performed the preparation of the tunnel in 11 patients with primary AVF, 7 men and 4 women on dialysis from 11.7 ± 7.8 months whose chronological age was 57.6 ± 24.3 years. The mean age of the AVF in these patients was 12.3 ± 9.7 months. The suitable sites selected should have the following characteristics: elastic skin, straight stretch of the vessel, not inflamed, scarred or already used areas. The statistical study was performed with the Fisher exact test. ***Results:*** First stage: preparation of the tunnel in 2 females and 5 males with AVF age of 12.1 ± 10.6 months by means of sharp needles 16 G. Only in 1 patient (male) the outcome was positive. In 6 patients the preparation of the tunnel was not successful. Second phase: we repeated the tunnel preparation in these 6 patients using 15 G needles, adding 4 new patients (2 females and 2 males). In this second phase, therefore, were treated a total of 10 patients with AVF age of 12.8 ± 9.7 months with 15 G needles. The preparation was successful in 9 patients, 1 patient had negative outcome. The difference was close to statistical significance with a P value of 0.059 at the Fisher exact test. ***Conclusion:*** In our experience we have seen a high success rate of the buttonhole technique, using 15 G compared with 16 G needles, regardless of age of the fistula. It should be noted, therefore, the importance of the gauge needle. For this we suggest the use of the 15 or larger size gauge sharpneedles. It is also important, in our opinion, to consider the possibility of extending the preparation of the tunnel over the 2 weeks recommended by current procedures.

Interventional Nephrology for the Preparation and Revision of Vascular Access for Hemodialysis: Experience of a Single Center

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Purpose: To develop an organizational model for making and revising the permanent vascular access (VA) in dialysis or starting

dialysis patients so that they have a valid and suitable VA. ***Methods:*** Patients who had to start dialysis were divided into 3 groups: group A with a glomerular filtration rate between 25 and 20 mL/min which is monitored every 2 to 3 months to assess the decline of the renal function and the time of surgery. Group B with glomerular filtration rate between 19 and 10 mL/min where the operation is planned within 30 days after the visit. Lastly group C (identified with the late referral) with glomerular filtration rate below 9 mL/min where the intervention is planned within 7 to 15 days. The revisions of the arteriovenous fistula, in patients on dialysis, were performed in 24 to 96 hours. In all cases, the patients were evaluated by the same team of nephrologists who took care of the management of VA. A physical examination was done with the Allen test and an ultrasound mapping following minimum criteria suggested by Robbin. If the patient had central venous catheter or cardiac devices such as pacemakers or defibrillators, a further evaluation with angiographic examination will be required. ***Results:*** From January 1, 2006 to April 30, 2010, 560 interventions for VA in 316 patients with ESRD undergoing hemodialysis were carried out. Of these 560 interventions, 414 were those for preparing or revisioning arteriovenous fistula, 16 interventions for arteriovenous graft and 15 for superficialization or transposition of the deep veins in the arm. One hundred fifteen interventions were performed for placement or revision of tunneled central venous catheter and 9 percutaneous angioplasty in the angiography room. The patients were from other hospitals for 46% of total. ***Conclusion:*** All this has allowed us, together with a multidisciplinary approach with radiologists, to prepare the most suitable VA for each patient with substantial reductions in complications. The results of the last 5 years comfort and encourage us to continue the road, which has been taken. We believe this is the best to solve, in a reasonably short time and with less discomfort, the VA problems of the patients who belong to our center hemodialysis and those who come from other hospitals.

Is Aggressive Protocolized Tissue Plasminogen Activator Effective in Reducing Catheter Recirculation?

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Background: Catheter recirculation (CR) in hemodialysis (HD) is the reversal of intravascular blood flow resulting in venous outflow directly entering arterial inflow without passage through the circulation. Clinically significant recirculation (CSR) is defined as Transonic® >10% and >20% with lines straight (S) and reversed (R), respectively. Rates reportedly reach 24% with lines S and 86% with lines R. Thrombus and fibrin sheath may cause CR; and thus respond to tPA, a treatment that has been successful in catheter dysfunction. Evidence to support tPA in CR is lacking. A protocolized approach was adopted at our institution, with concomitant data collection. The rate and significance of CR were also queried. ***Methods:*** Data collected included line type, site, vintage and position; dialysis blood pump speed; and preprotocol and postprotocol urea reduction (URR) and CR.The protocol, in place for 9 months, was initiated by a URR <65% on routine labs and CSR. The tPA given was 4 mg infusion and 1 mg lock and dwell for 3 consecutive HD sessions. A second series was given if indicated, followed by a line change if unsuccessful. A 50% reduction in measured CR was targeted. Extrapolated from response of catheter dysfunction to tPA, primary outcome was set at 80% of protocol initiations. ***Results:*** Of 134 patients on HD via catheter, 46 had URR <65% across 93 labs. The mean ± SD CR with lines S and R was 3.1 ± 5.9% (n=18) and 32.3 ± 15.2% (n=75), respectively. There were no associations between line type (brand or length), site (vein and side), or vintage, and CSR. Lines R were significantly associated with CSR (P=0.03).Thirty-five patients had CSR and met criteria for tPA. Two patients had lines S; 33 had lines R with 37.9 ± 12.2% CR (n=58). Twenty-three complete protocols were available for 19 patients. Catheter recirculation decreased 5.5 ± 56.3%. Six (26%) protocols achieved target, all to Transonic® <20%. A second series was given for 6 protocols, from which an additional 1 achieved target. ***Conclusion:*** Catheter recirculation is common when lines are R; rates at our institution echo those previously reported. Despite an unachieved primary outcome, tPA may be useful for CSR, as evidenced by a 26% success rate in this study.

Clinical Significance of Early Postoperative Venography of Vascular Access

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Introduction: Venography has been a standard method to detect vascular access dysfunction (VAD) under maintenance hemodialysis (HD). However, there has been few data about the venography to verify VAD before first needling. ***Methods:*** From August 2004 to April 2010, 300 patients received vascular access operation. Venography was performed 4 to 6 weeks after the operation and before first needling for HD. ***Results:*** Mean age of the patients was 56 ± 13 years. Males and females were 148 and 152, respectively. One hundred seventy-five out of 300 had diabetes mellitus. Vascular access comprised 237 arteriovenous fistulas (192 radiocephalic, 25 bracihocephalic, and 20 brachiobasilic) and 63 arteriovenous grafts. Venography revealed 31.3% (n=94) of severe stenosis, which required further intervention such as percutaneous transluminal angioplasty (PTA) or reoperation. Out of 300 patients, 40.7% (n=122) showed good patency and 28% (n=84) had mild stenosis. For 31.4% (n=94) with severe stenosis, PTA and reoperation were performed in 70.2% (n=66) and 17% (n=16), respectively. Out of 86 patients with mild stenosis, 65 patients were followed for 1 year and VAD occurred in 13 patients (20%) and 11 patients received successful PTA. Out of 122 patients with normal venography, 102 patients were followed for 1 year and VAD did not occur in any patients. ***Conclusion:*** Early postoperative venography before first needling is helpful to detect and treat early VAD in HD patients.

Pull-Back Venographic and the Gross Findings

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Purpose: The number of tunneled cuffed catheter (TCC) in hemodialysis (HD) patients is increasing, however, there are few data about natural history of TCC removed in asymptomatic HD patients. The purpose of this study is to evaluate pull-back venographic and gross findings of removed TCCs. ***Methods:*** One hundred two TCCs were removed between March 2009 and June 2010. Pull-back venography was performed and we recognized the presence of fibrin sheath around the catheter, filling defects suspicious of thrombus and stenotic lesions. Removed TCCs were cut at 1 and 2 cm from the tip and intracatheter fibrin and thrombi were grossly investigated. ***Results:*** Mean age of the patients was 57.8 ± 13.5 years and 60 patients (58.8%) were men. Patients with diabetes mellitus accounted 65.7% (n=67). A total of 45 (44.1%) of 102 cases had abnormal venographic findings such as fibrin sheath (35.3%), thrombus (7.8%), and stenosis (2.9%). Intracatheter fibrin and thrombus was detected in 53 (51.9%) catheters by gross evaluation of cut lumen. Overall, 74 (72.5%) out of 102 patients had catheter related complications on the inside or outside of the catheter. ***Conclusion:*** This study shows that a considerable number of asymptomatic HD patients have catheter-related problems. The reduction of the number of dwelling TCCs is thought to be more important than the adequate management to prevent complications.

The Impact of Arterial Microcalcification on Aortic Stiffness and Endothelial Dysfunction in Patients with End-Stage Renal Disease

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Purpose: Although vascular gross calcification by radiologic study is known as a risk factor for cardiovascular morbidity and mortality in end-stage renal disease (ESRD) patients, the role of arterial microcalcification (AMC) by histologic evaluation is not reported yet. ***Methods:*** Sixty-five ESRD patients awaiting vascular access operation were included. Aortic stiffness and flow mediated dilation were evaluated with pulse wave velocity (baPWV) and flow-mediated dilatation (FMD) of the brachial artery, respectively. Diagnosis of AMC was made by von kossa staining. ***Results:*** Mean age of the patients was 60 ± 12 years and patients with diabetes mellitus accounted 70.8%. The AMC was detected in 36 patients (55.4%). The AoAC score was higher in the positive AMC group compared with the negative AMC group (P=0.001). The baPWV was also higher in the positive AMC group, compared with the negative AMC group (26.5 ± 9.4 vs. 19.8 ± 6.6 m/s, P=0.006). But there was no difference in FMD between the 2 groups (5.4 ± 2.6% vs. 5.7 ± 3.5%, P=0.764). ***Conclusion:*** This data showed that AMC at vascular access site was related to baPWV but not to FMD in ESRD patients. We suggest that AMC is associated with cardiovascular morbidity and mortality via aortic stiffness in ESRD patients.

Using Angiocaths to Create Buttonhole Tunnel Tracks

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Establishing buttonhole access requires a series of cannulations with sharp needles to create scar-tissue tunnel tracks before the cannulation with blunt needles. This method poses challenges including: fragility of blood vessel walls leading to repeated infiltrations and development of blind tracks resulting from multiple cannulations caused by different needle insertion angles, directions, and depths. A successful method that leaves 2 angiocaths in situ for up to 14 days to establish scar tracks to facilitate subsequent cannulations with blunt needles has been reported in the literature.[1] A pilot project was developed using this methodology. Thirty-nine patients in 13 home dialysis centers participated in the project. A flexible angiocath (Clampcath), a telescopic needle retraction system and introducer needle were used to establish buttonhole access. The angiocath was secured with tape and left in place from 4 to 17 days, with a transparent dressing over the site. Frequent inspections by staff or patients were performed including twice weekly dressing changes. Patients were taught to keep the dressing dry and report signs of infection. No infections were noted. Complications included bleeding around the site, which was exacerbated by movement, especially in upper arm access. In all but 1 case, bleeding was minimal. Accidental dislodgement of angiocath, especially during dressing changes occurred. Skin rash under the dressing was also seen. Buttonholes failed to form after 14 days in 9 patients with risk factors that included older age, diabetes, and fistulas requiring revision. The remaining patients developed patent buttonhole access. The angiocath method resulted in a reduction of blind track development, decreased risk of infiltration and less painful cannulation. When properly utilized, angiocath method provides clinicians another tool to establish buttonholes successfully with less trauma for the patient.

Reference 1. Marticorena, et al. *Hemodial Int*. 2009;13(3):316–321.

The Benefits of a Central Venous Catheter to Peritoneal Dialysis Catheter Conversion Program

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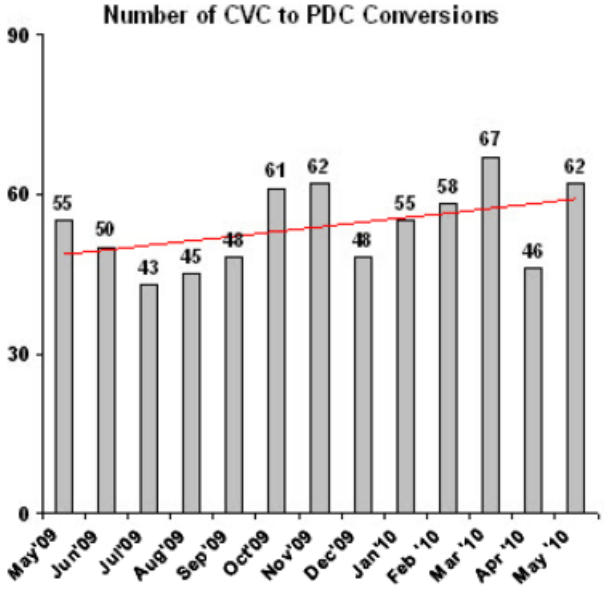
Introduction: Central venous catheter (CVC) to peritoneal dialysis catheter (PDC) conversion is a collaborative effort between the in-center hemodialysis (ICHD) team and the peritoneal dialysis (PD) team to transition appropriate patients from a CVC to a PDC. Patients with CVCs are at higher risk for increased infection, morbidity, mortality, and hospitalizations. The opportunities to convert patients from CVC to PDC include ICHD patients with exhausted accesses, new ICHD patients with a CVC, patients who are needle phobic or have body image issues with having a fistula placed, ICHD patients with a clotted access who may not want to have another vascular access placed, and patients who have

experienced chronic hemodialysis access infections. ***Methods:*** The CVC to PDC initiative started in May 2009 and is conducted in partnership with DaVita Inc.'s CathAway program, which supports reducing the number of patients with CVCs. The CVC to PDC program begins with patient education outlining the benefits of PD as an alternative dialysis therapy. The care team identifies appropriate CVC patients who are potential PD candidates and partners the patient with a PD nurse to explain the benefits of the dialysis therapy. Once the patient, family, and physician agree to begin PD therapy, the patient is scheduled for PD catheter placement and PD therapy training. ***Results:*** From May 2009 to May 2010, a total of 700 prevalent patients have converted from CVCs to PDCs (figure). Approximately 76% of the patients are still actively using the PDC. ***Conclusion:*** Through collaborative cross-discipline efforts, this program has proven effective in CVC removal for patients going from ICHD to PD. Dedicated support from the nurse, vascular access manage, social worker, and physician was provided for those patients requiring further education on the importance of PDC conversion. By having their CVC removed patients are less likely to experience infection and hospitalizations related to CVC use and thus have an improved quality of life.



Adequacy

Acute Kidney Injury: Shift Continuous Venovenous Hemodialysis Dose

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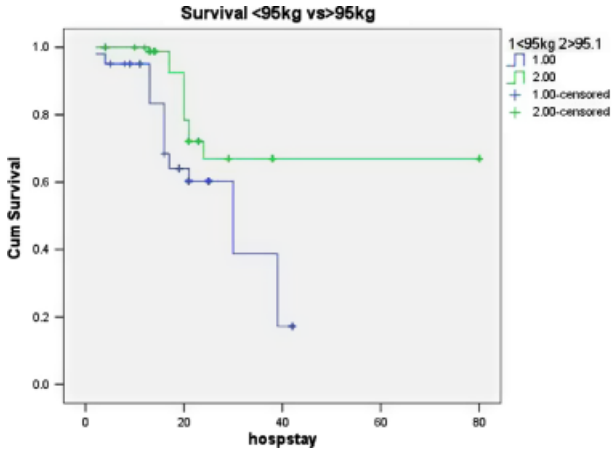
Introduction: The treatment of acute kidney injury (AKI) requiring dialysis is controversial regarding the modality and dose. ***Material and Methods:*** Analysis of a 6-month cohort of AKI patients treated with shift continuous venovenous hemodialysis (CVVHD) (Nxstage 8 hours 40 L dialysate per session), demographics, lab data, and survival obtained from the EMR, technical and monitoring details from the dialysis run sheet pre-BUN/post-BUN Kt/V urea reduction (URR), CVVHD dose (mL/kg/h) per standard methods, data as mean and SD. ***Results:*** Thirty-nine patients with AKI requiring dialysis (43.6% sepsis, 28.2% CV surgery, 28.2% other), mortality 39% (52.9% sepsis, 62.6% CV surgery, 18% other), 8.1 days on dialysis, 19.2 days in the hospital, 196 treatments were analyzed; mean age 55.9 years (19), weight 106 kg (62), dialyzed for 7.1 hours (1.6), QB 300 mL/min (45), dialysate K 2.75 mEq/L (0.5), vasopressor 197 (46), heparin 1374U (1600), hypotension/h 0.15 (0.3), pre-MAP 82.3 mmHg (15), post-MAP 83.3 mmHg (14), ultrafiltration 3.4 L (1.7), ultrafiltration 483 mL/h (248), URR 44.5% (14.6), Kt/V per session 0.81 (0.32), CVVHD dose 55.8 mL/kg/h (21.2). Nonsurvivors had a higher albumin (2.2 vs. 1.9 g/dL), lower phosphorous (4.7 vs. 5.7 mg/dL), lower predialysis BUN (68 vs. 78 mg/dL), $P<0.05$. Good correlation between Kt/V and dose CVVHD ($r=0.75$). Inverse correlation between weight and Kt/V and dose CVVHD. Heavier patients (>95 kg) had a better survival rate despite receiving a lower dose of CVVHD. ***Conclusion:*** Shift CVVHD is a method of RRT that can be used for AKI requiring dialysis. The survival is similar to other methods, the dose of dialysis, as measured (URR Kt/V mL/kg/min), did not differ between survivors and nonsurvivors suggesting that other factors affect the survival outcome (weight).



Inpatient Hemodialysis: How are we Doing?

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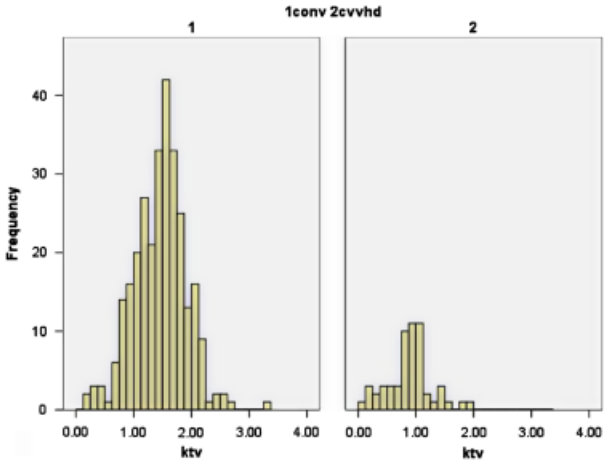
Background: Inpatient hemodialysis is an important part of the nephrology practice. There are not many descriptions of the

details and quality of the procedure. ***Methods:*** We analyze 3 consecutive months of all end-stage renal disease patients admitted to the hospital who had at least 1 treatment. Data from patients obtained from EMR dialysis data from the dialysis run sheets. Conventional hemodialysis (HD) (Fresenius) and continuous venovenous hemodialysis (CVVHD) (Nxstage). Pre-BUN/post-BUN obtained by protocol. Data is shown as mean and SD. ***Results:*** Four hundred thirty-six treatments were analyzed 86.4% conventional HD, 50.1% with AV access (AVF, AVG) 46.4% with IJ catheters, 3.5% femoral, 58.7% male, age 55.9 (13) weight 78.6 (17) kg. ***Conventional Dialysis:*** Mean arterial pressure (MAP) predialysis 94.9 (22) mmHg, QB 388 (53) mL/min, QD613 (87 mL/min) dialysate K 2.5 (0.6) mEq/L, HD time 228(43) min, ultrafiltration (UF) 3325 (1528) mL, UF/h 796 (426) mL/h, urea reduction (URR) 68.4 (13)%, Kt/V 1.4 (0.4). ***CVVHD:*** Mean arterial pressure predialysis 86.1 (17) mmhg, QB 300 (15) mL/min, dialysate K2.9 (0.4) HD time 452(70) min, UF 3143 (1375) UF/h 313 (184) mL/h, URR 46 (16)% Kt/V 0.8 (0.5) dose of CVVHD 65 (7) mL/kg/min. Conventional vs. CVVHD ($P < 0.05$): Kt/V and URR lower per treatment (more frequent CVVHD 5–6/wk), post-BUN lower, precreatinine, higher, higher QB, lower dialysate K, shorter HD time, higher MAP predialysis, higher UF/h, higher hypotension per hour. No difference in the Kt/V obtained with catheter vs. AV (arteriovenous fistula, arteriovenous graft). No difference also in the CVVHD dose. The dose of dialysis as Kt/V was 1.37 (0.4) P25:1.01 P75:1.6. For CVVHD was 65.7 (9.7) mL/kg/h P25:58.3 P75:72.8. ***Conclusion:*** Inpatient HD is effective and delivers adequate dose in the majority of patients in the hospital. No difference despite the different vascular access, compared with CVVHD it obtained a higher Kt/V UF and had more episodes of hypotension/h. It is important to monitor the delivery of dialysis in the hospital.



Hemodialysis Dose (Kt/V): Comparison of Two Formulas and an Online Clearance Monitor

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Introduction: The hemodialysis (HD) dose should be measured to estimate whether treatment is appropriate. It has been recommended, by NKF-DOQI guidelines, to keep a spKt/V > 1.2. Currently there are dialysis machines that offer online monitoring (OCM) of dialysis efficiency and show the Kt/V in real-time on screen. The aim of this study is to compare Kt/V measured by the OCM and Kt/V obtained by blood samples, using the formulas of Lowrie (L) and Daugirdas (D) second generation. ***Methods:*** Observational cross-sectional study. Fifty-three patients on HD at São Lucas Hospital. Data were collected at the same dialysis session, with preurea and posturea, ultrafiltration volume and reading of Kt/V on OCM from Fresenius 4008S. ***Results:*** Ninety-five sessions were analyzed. The majority of patients were male 52 years old (55%), with mean age of 57.1 ± 14. Hypertension was the most prevalent etiology if chronic kidney disease with 39% (37) followed by diabetes 20% and polycystic kidneys 9% (8). The mean hematocrit level was 32.9 ± 4.9. Dialysis doses calculated from L, D, and OCM were 1.31, 1.41, and 1.32, respectively. The comparison between the 3 formulas has shown that there is no statistical difference among L and OCM ($P = 0.795$); however, a difference was found between D and OCM $P = 0.000$. A Pearson correlation of 0.950 was found between D and L, a weaker correlation with D and OCM 0.396 and 0.557 with OCM and L. ***Conclusions:*** We can conclude that the Kt/V on line can be used as an indicator of adequacy of dialysis.

Moderately High Hemodialysis Dose is Associated with Lower Platelet Count

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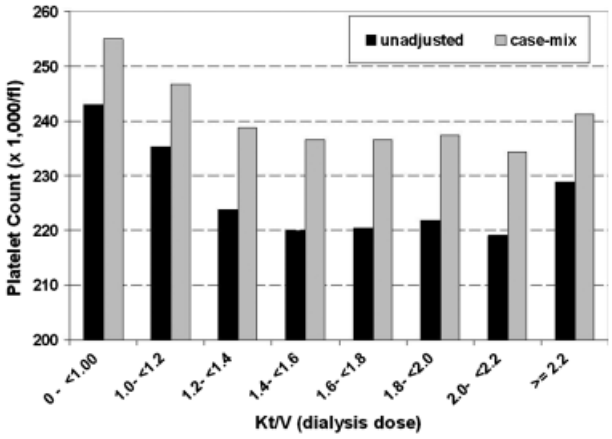
Background: We have shown that moderately high dialysis dose (achieved single pool Kt/V of 1.6–2.0) is associated with greater survival in maintenance hemodialysis (MHD) patients. Because platelet reactivity plays a central role in the genesis of thromboembolic events, we hypothesized that low Kt/V is associated with higher platelet count (relative thrombocytosis). ***Methods:*** Using linear regression models, we examined associations between 3-month averaged Kt/V (achieved, single pool) and platelet counts during July to December 2001 in a cohort of 40,697 MHD patients from all DaVita clinics in the United

States. Models were adjusted for case-mix. ***Results:*** Patients were 61 ± 15 years old and included 47% women, 46% diabetics, and 34% African Americans. The 13-week averaged platelet count was 229 ± 78 × 10^3/μL. In unadjusted, and case-mix adjusted models, incrementally higher Kt/V values up to 2.2 were associated with lower platelet count whereas Kt/V below 1.2 or above 2.2 exhibit highest thrombocytosis (see figure).



Conclusions: Lower hemodialysis dose in MHD patients is associated with relative thrombocytosis, which may explain the poor outcomes observed with inadequate dialysis treatment. Additional studies need to verify these findings.

Anemia

Anemia and Vitamin D Deficit in Chronic Kidney Disease Stages 2–5ND: a New Vitamin D Pathogenic Role?

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Patients with chronic kidney disease (CKD) are at high risk for cardiovascular disease and mortality remains high. Vitamin D deficiency appears at early stages of CKD playing a biologic role as pleitropic hormone. Our aim in cross-sectional study is to assess the vitamin D influence on anemia in CKD 0.563 patients were enrolled, mean age 68–13 years, mean GFR 46.67 ± 23.9 mL/min/1.73 m^2, 38% female and 30% DM, mean Hb level 13.16 ± 1.68 g/dL. Anemia-defined Hb level < 12.5 g/dL was in 201 patients (35.9%). Parameters analyzed were anemia, nutritional inflammation, cardiovascular, and mineral bone disease. Data were analyzed with SPSS 15 (SPSS, Chicago, IL, USA). Anemic vs. nonanemic, anemic were older (71.17 ± 11.79 vs. 66.03 ± 13.7 years, P < 0.001), diabetic (35.6 vs. 25.7%, P < 0.001), lower GFR (36.54 ± 17.9 vs. 52.36 ± 25.0, P < 0.001).

T-paired test

Variable	Anemic (N = 201)	Nonanemic N = 359	P
Serum albumin (g/dL)	4.18 ± 0.41	4.34 ± .30	0.001
Prealbumin (mg/dL)	29.93 ± 6.96	31.62 ± 7.13	0.001
Calcium (mg/dL)	9.20 ± 0.53	9.38 ± 0.41	0.001
Phophorous (mg/dL)	3.76 ± 0.83	3.41 ± 0.61	0.001
Parathormone (pg/mL)	100 ± 96.8	68 ± 57.3	0.001
Ca × P (mg^2/dL^2)	34.59 ± 8.11	32.52 ± 6.66	0.001
25 vitamin D (ng/mL)	16.7 ± 9.47	18.6 ± 10.7	0.043
1,25 D_3 (pg/mL)	34.6 ± 14.24	40.85 ± 16.43	NS
Urinary Alb/Cr index (mg/g crea)	541.63 ± 1260	295.2 ± 598	0.001

Conclusion: Vitamin D is significantly lower in anemic patients. Further studies are required to explore the effects of 25D on erythropoiesis in CKD patients.

Effect of Intravenous and Oral Ascorbic Acid in Hemodialysis Patients with Anemia and Hyperferritinemia

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Hemodialysis patients with anemia and hyperferritinemia often develop resistance to recombinant human erythropoietin (EPO). Ascorbic acid is believed to improve anemia in hemodialysis patients. We evaluated the efficacy of intravenous and oral ascorbic acid on Epo-hyporesponsive anemia in hemodialysis patients with hyperferritinemia. Forty-seven of 156 hemodialysis patients with Hb < 11 g/dL and ferritin levels > 300 ng/mL were prospectively followed-up. Patients were randomly divided into 3 groups: 16 patients who received standard care (group 1), 17 patients who received standard care and daily oral ascorbic acid at a dose of 500 mg/d (group 2), and 14 patients who received standard care and 300 mg of intravenous vitamin C with each dialysis session (group 3). Each group was similar in clinical characteristics. Blood samples for measurement of hemoglobin, hematocrit, serum iron, ferritin, transferrin saturation, and EPO dose were obtained at baseline and after 3 months of treatment. After 3 months, hemoglobin and hematocrit and transferrin saturation levels significantly increased in groups 2 and 3 (P < 0.05) but not changed in group 1. Erythropoietin dosage and ferritin levels decreased in groups 2 and 3 (P < 0.05). There was no difference in groups 2 and 3. In conclusion, our study has demonstrated that intravenous or oral ascorbic acid therapy can improve anemia, hyperferritinemia and EPO resistance in hemodialysis patients. The effects of intravenous and oral ascorbic acid are similar. Further studies are needed to determine ascorbic acid dosing optimization.

Once-Monthly Anemia Management with CERA Maintains Stable Hemoglobin Levels in Hemodialysis Patients: Results from the HbDay Study

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Objective: Methoxy polyethylene glycol-epoetin β is a continuous erythropoietin receptor activator (CERA) and provides the maintenance of stable hemoglobin (Hb) levels in hemodialysis patients with once-monthly administration. Chronic kidney disease patients with renal anemia undergoing treatment with an erythropoiesis-stimulating agent (ESA) can be given supplementary iron to maintain the Hb target. The HbDay study evaluates the maintenance of stable Hb levels with an intravenous supplementary iron (iron hydroxy/dextran), on the same day as the subcutaneous administration of CERA every 4 weeks. ***Material and Methods:*** This "real-life" observational study is based on a 9-month period in a single center. The data on Hb level, iron status and ESA treatment was collected retrospectively for a 3-month period before the once-monthly anemia management and during the next 6 months. Hundred twenty-five hemodialysis patients were evaluated (48% female), the mean duration on dialysis is 5 years and the mean age is 73 years. Age distribution is <65 years, 25%, 65 to 75 years, 21%, 75 to 85 years, 38%, ≥ 85 years, 16%. ***Results:*** The Hb level and iron status are stable during the study. The mean Hb level is 11.1 ± 1.33 g/dL in baseline (1 week before the start of CERA) and 10.9 ± 1.21 g/dL, during the evaluation at W24 ($P=0.242$) of the patients are between 10 and 12 g/dL in baseline and 66% during the evaluation. During the evaluation at W24, the mean serum ferritine is 363 μg/L, the mean transferrine saturation is 26%, the median dose of iron hydroxyl/dextran is 200 mg/mo and the median dose of CERAis 150 μg/mo (45% patients with the same dose as the baseline, 33% decrease and 22% increase). ***Discussion:*** The Hb levels can be maintained in hemodialysis patients with both administrations of iron supplementation and CERAon the same day every 4 weeks. ***Conclusions:*** This "real-life" study in a intensive dialysis center shows that the once-monthly anemia management can be effective. This is an opportunity to simplify the organization of dialysis centers and as a result make them more cost effective.

Serial Changes of Hemoglobin Variability in Maintenance Hemodialysis Patients Treated with Erythropoiesis-Stimulating Agents: Associations with Life Prognosis

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Objectives: Retrospective analyses were performed to clarify the relationship between serial changes of hemoglobin (Hb) variability and life prognosis in patients undergoing hemodialysis (HD) treated with 2 different erythropoiesis-stimulating agents. ***Methods:*** Data were analyzed for 184 patients observed from January 2008 to December 2009. All patients were treated with intravenous administration of either recombinant human erythropoietin (750–9000 U/wk) or darbepoetin (DPO; 10–120 μg/wk) in order to maintain a target Hb level between 10.0 and 12.0 g/dL. The 184 cases were divided into 2 groups according to the ESA; Group A (erythropoietin: n=96, M:F=69:27, age=62.19 ± 15.66 years, HD duration=82.1 ± 66.9 months) and Group B (DPO: 88, 58:30, 64.48 ± 17.97, 85.1 ± 49.9). The weekly average values of Hb were measured at 2-day intervals just before HD. The Hb variability classified according to the following categories as reported by Ebben, et al.[1]—consistently low (L), consistently within the target range (T), consistently high (H), low amplitude low (LAL), low amplitude high (LAH) and high amplitude (HA)—was adopted and serial changes of Hb variability that occurred between 2008 and 2009 were analyzed in all 184 patients. The life prognosis of each patient was also examined until September 2010. ***Results:*** (1) According to Hb variability in 2008, the numbers of patients classified into 6 categories were as follows: HA (Group A: 56 cases, 57.8% vs. B: 59, 67.0%), LAH (A: 16, 16.5% vs. B: 21, 23.9%), LAL (A: 21, 21.6% vs. B: 8, 9.1%), H (A: 2, 0.02% vs. B: 0, 0.0%), and T (A: 1, 0.01% vs. B: 0, 0.0%). Significant differences ($P<0.05$) between 2 groups were found in HA, LAH, and LAL. (2) Maintenance of HA in both years could be seen in 20 cases out of 48 (41.7%) in A, and 33 out of 52 (62.5%) in B. Marked differences were detected between 2 groups ($P<0.05$). In Group A, 5 out of 17 patients (29.4%) changed from LAL in 2008 to HA in 2009, in B, 6 out of 8 (75.0%) patients changed ($P<0.01$). At the same time, 19 out of 48 (39.6%) cases in A changed from HA to LAL, while 5 out of 49 (10.3%) cases in B made a similar change ($P<0.01$). (3) The relationship between Hb variability in patients 1 year before death and the number of deaths in both groups could be seen as follows: in HA, 8 patients (50.0%) in Group A and 11 (91.7%) in B; in LAH, 5 (31.1%) in A and 1 (8.3%) in B; in LAL, 2 (12.5%) in A and 0 (0.0%) in B; in L, 0 (0.0%) in A and 1 (1.3%) in B. ***Conclusions:*** These results indicate that patients classified into HA show poor prognosis; additionally, adjustment to an adequate Hb level is more difficult in patients treated with DPO owing to a higher incidence of HA and also because patients who turn from HA to LAL are fewer in number.

Reference 1. Ebben, et al. *Clin J Am Soc Nephrol*. 2006;1:1205–1210.

Patient-Centered Data-Based Physiologic Erythropoietin (EPO) and IV Iron Dosing in Hemodialysis Patients Boosts Hemoglobin and Reduces EPO Requirement and Costs

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Background: Erythropoietin (EPO) dosing has been driven by guidelines and changing Medicare regulations rather than patient

physiologic responses. Recent US EPO dosing is high (17,996 U/wk); Medicare changes now encourage reduced EPO doses. Long-term HD patient survival was shown to be best with hemoglobin (Hb) > 12 g/dL, TSAT > 25%, moderate IV iron, relatively low EPO (*BMC Nephrology* 2009, 10:6). Retrospective analysis of prospectively collected individual patient data from 3 dialysis units (The Rogosin Institute, New York, NY) in a patient-centered EMR (MIQS Inc., Boulder, CO) showed that expected Hb change lagged EPO dose changes by many weeks. Over short (4–12 weeks) and long periods (8–12 years) EPO given to individual patients varied widely, sometimes within weeks, with no obvious reasons, and with high Hb variance. 25% of patients were iron insufficient (TSAT ≤ 25%). In unit A (250 patients receiving EPO) a new dosing model was initiated in February 2010; using the traditional dosing model, units B and C (202 and 169 patients receiving EPO, respectively) served as controls. ***Objectives:*** Hemoglobin and iron sufficiency (TSAT persistently ≥ 25% and serum ferritin ≥ 300 μg/L), low Hb variance, modest/low EPO dosing. ***Method:*** Evaluate EPO and iron status not more frequently than 4 to 8 weeks using a reporting tool for each patient that aggregates hematologic data and hematinic medications monthly for the prior 18 months. ***Actions:*** Replete iron IV as needed; maintain, adjust downward, but do not stop EPO. ***Results:*** Unit A: by September 30, 2010 (i.e., after 8 months), Hb increased 4.5% from 11.42 to 11.93 g/dL, Hb variance decreased from 1.21 to 0.68 g^2/dL^2, IV iron given increased 38% from 184 to 253 mg/mo, and median patient TSAT increased from 27% to 33.5% while EPO decreased from 15,100 to 9,730 U/wk. Units B and C: EPO doses decreased by 13% and 14% to 19,000 and 17,600 U, but Hb was unchanged at 11.48 g/dL in unit B and decreased by 1.3% to 11.16 g/dL in unit C. ***Conclusion:*** The new dosing model facilitated orderly EPO reduction, and increased Hb and iron sufficiency. The allowable payment for EPO administered decreased by 37% to $37.50 per HD treatment for those receiving EPO. When all patients, including the 15 in Unit A not receiving EPO are considered, the allowable EPO cost per HD treatment for all patients in the unit was $35.40.

Cinacalcet Hydrochloride Improved Chronic Inflammation, and Decrease the Dosage of Erythropoiesis Stimulating Agent

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Methods: Nineteen out of 157 chronic dialysis patients in our facility have been followed under the treatment of CH for 1 year based on our therapeutic policy for 2 HPT (CH group). The rest 138 patients have been also followed as a control (Cont group). Serum levels of intact PTH (i-PTH), albumin, high-sensitive C-reactive protein (hs-CRP), and the dosages of darbepoietin-α (DA; μg/wk) have been monitored before and 1 year after CH. The patients in each group were divided in to 3 subgroups by the preratio/postratio in high-sensitive C-reactive protein; subgroup 1 (< −10%), subgroup 2 (−10% to +10%), subgroup 3 (> +10%). ***Results:*** In the CH group, the serum level of i-PTH was significantly reduced in each subgroup, whereas the dosage of DA was clearly decreased only in subgroup 1. The levels of Hb, albumin did not change significantly in each subgroup (Table 1). In the Cont group, there were not significant changes in i-PTH, Hb, and dosages of DA in each subgroup.Bone density, the iron saturation level, and volume of parathyroid in the CH group did not change (data not shown). ***Conclusions:*** The reduction of ESA dosage in the relation to the improvement of inflammation was only observed in the CH group. It suggests that CH improves responsiveness to ESA by improving the systemic inflammatory status.

Table 1 Parameters in CH group

	N	i-PTH (pre) (pg/mL)	i-PTH (post) (pg/mL)	Hb (pre) (g/dL)
Group 1	5	575.0 ± 424.0	150.0 ± 59.9*	11.7 ± 1.8
Group 2	10	475.1 ± 238.5	143.2 ± 41.0*	10.9 ± 2.5
Group 3	4	432.5 ± 184.7	79.0 ± 29.8*	11.4 ± 0.4
	N	Hb (post) (g/dL)	DA (pre) (μg/wk)	DA (post) (μg/wk)
Group 1	5	12.0 ± 1.8	19.0 ± 12.5	6.0 ± 5.5*
Group 2	10	10.8 ± 3.5	8.3 ± 7.5	9.8 ± 10.0
Group 3	4	11.2 ± 0.9	3.3 ± 2.4	10.0 ± 8.2

*$P < 0.05$.

Calcium, Phosphorus, Bone

Sagliker Syndrome in Long-Term Hemodialysis Patient

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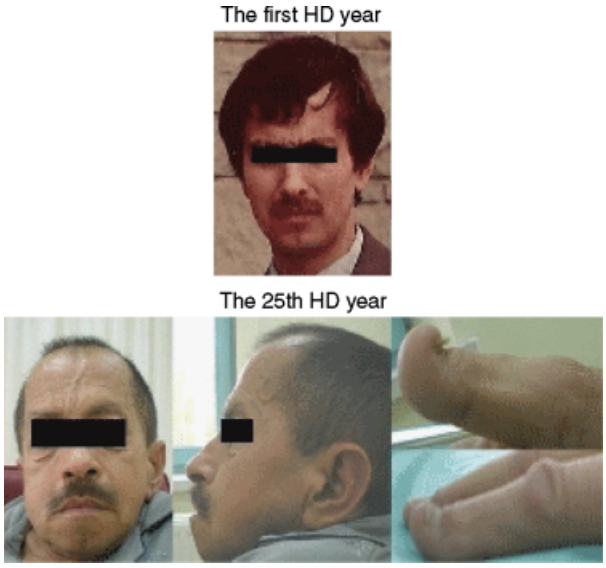
Background: Sagliker syndrome is one of the most severe manifestations of secondary hyperparathyroidism (sHPT) complicating chronic kidney disease. ***Case Report:*** A male patient, 49.6 years old, was treated with hemodialysis (HD) since November 1985 due to end-stage renal disease in the course of chronic glomerulonephritis. In 1994 to 1995, total alkaline phosphatase activity was 1950 − 1235 IU/L, respectively. In 1995, he suffered fracture of the left femoral neck. In 1996, bone scintigraphy showed typical image of sHPT, but (99 m) Tc-MIBI scintigraphy did not reveal enlargement of parathyroid glands. First available serum parathyroid hormone level of 1681 pg/mL is from January 2004; the last one of 1189 pg/mL is from July 2010. Osteoporotic fractures of bone spine, scoliosis, and kyphosis resulted in a decrease of height from 176 to 151 cm. Sagliker syndrome developed over the last 20 years: characteristic face appearance, lower height than in the previous

years, peculiar appearance of the fingertips: upward curved development of phalanges. Only pharmacological medication of sHPT (aluminum hydroxide in the past, calcium carbonate, active vitamin D, recently cinacalcet) was used in the course of dialysis treatment.



Conclusion: In the XXI century, despite great advances in medicine it is still possible to meet patients with characteristic human face appearances and other disturbances of the skeletal system, which emerged in the course of untreated or inadequately treated sHPT.

Estimating the Binding Capacity of Available Phosphate Binders: A Rational Basis for Prescribing

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Background: Adjusting phosphate binder (PB) dose based on dietary phosphate intake can help to manage hyperphosphatemia in dialysis patients. To do this effectively, knowledge is needed of the phosphate-binding capacity of each available PB. ***Methods:*** In this analysis, dietary phosphate absorption was evaluated in dialysis patients and healthy volunteers. Binding capacities of PBs were calculated using data from a metabolic study comparing lanthanum carbonate and sevelamer carbonate in healthy volunteers, and published results of other trials in which phosphate binding was measured directly in the gastrointestinal tract. These results were compared with estimates based on urinary phosphate excretion. ***Results:*** In hemodialysis patients, ingested phosphate absorption ranged from 60% to 86%, depending on vitamin D status. In studies in healthy volunteers, around 75% to 80% of phosphate was absorbed. Phosphate-binding capacity of PBs calculated from metabolic balance studies in healthy volunteers ranged from 63 mg with sevelamer carbonate (2400 mg dose) to 116 mg and 135 mg with calcium carbonate and lanthanum carbonate, respectively, and 177 mg with calcium acetate (all 1000 mg doses). Based on urinary excretion studies, binding capacities ranged from 31 mg and 36 mg with calcium carbonate and sevelamer hydrochloride, respectively, to 132 mg with calcium acetate and 79 to 156 mg with lanthanum carbonate (all 1000 mg doses). Using available formulations of these PBs, binding of typical excess daily dietary phosphate (~250 mg) would require 2 to 3 lanthanum carbonate 1000 mg tablets, 8 to 11 calcium acetate 667 mg tablets (containing 169 mg calcium), 9 to 12 sevelamer 800 mg tablets, and 5 to 21 calcium carbonate 400 mg tablets. ***Conclusion:*** Compared with other PBs, fewer lanthanum carbonate tablets are required to bind typical excess phosphate. These data may be useful to allow patients and their health care providers to provide a rationale for PB dosage.

Case Management of Calciphylaxis in Extended Therapy Hemodialysis Patient

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Thirty-three-year-old white male with end-stage renal disease secondary to obstructive uropathy, LRD transplant September 1985 to January 1988, March 1988 cadaveric renal allograft until March 2000 until rejection secondary to membranoproliferative GN in which patient resumed traditional in-center hemodialysis. Patient has several comorbid conditions including HTN, DVT, plasma exchange s/p IVC filter, afib, CHF/restrictive cardiomyopathy, chronic hyperphosphatemia, and secondary hyperparathyriodism. The patient was transferred to extended nocturnal in-center dialysis, 3 times/wk for 8-hour sessions in 2006. Eight 2009 patients developed painful ulceration to left breast, which was mammogram negative for cancer. Plan of care for this lesion was wound management, discontinuation of coumadin and continuing of extended hemodialysis therapy. Left breast lesion resolved within 1 year. In May 2010, 3 more painful lesions erupted to right shoulder, left leg and fingers, biopsy proved calchiphylaxis and initiated the use of sodium thioslufate 12.5 g per dialysis session along with aggressive wound management from wound clinic. Patient was actively tolerating IV sodium thiosulfate and lesions were healing with active management. The increase of sodium thiosulfate from 18.75 to 25 g per dialysis session was tried. ***Discussion:*** Calciphylaxis is a poorly understood and highly morbid syndrome of vascular calcification and skin necrosis. Lesions can develop thick, dark crusts, and open very painful debilitating skin ulcers. Diagnosis includes skin biopsy. Management includes IV sodium thiosulfate, lab monitoring, correction of hyperphosphatemia, discontinuation of calcium and vitamin D supplementation, and anticoagulation therapy if warranted. Despite aggressive treatment regimens, calciphylaxis still has a high mortality rate. Research has demostrated the benefits of extended dialysis therapy in the successful management of calciphylaxis.

Aortic Calcification in Hepatitis C-Seropositive Prevalent Hemodialysis Patients

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Aortic calcification is very common in prevalent hemodialysis patients. The liver has an important role in synthesis or activation of natural calcification inhibitors, e.g. fetuin A and matrix gla-protein. The aim of this study is to assess frequency of aortic vascular calcification in hepatitis C-seropositive chronic prevalent hemodialysis patients. Twenty heptitis C-seropositive (by ELISA) prevalent hemodialysis patients, as well as another 20 hepatitis C-seronenegative (by both ELISA and PCR) prevalent hemodialysis patients were randomly selected from our hemodialysis unit. The 2 groups of patients were similar in age, sex, BMI, and duration of hemodialysis. All patients were studied by routine biochemistry including serum calcium, PO_4, albumin in addition to PTH (Intact), Ultrasensitive C-reactive protein, and CT scan of abdominal aorta to aortic calcification index (ACI). We detected significantly lower ACI in hepatitis C-seropositive patients in comparison with seronegative patients. On the other hand, we did not detect significant difference between seronegative and seropositive groups regarding serum Ca, PO_4, albumin, Ca to PO_4 product, C-reactive protein, PTH level and calcium carbonate nor vitamin D intake. Although serum liver enzymes and bilirubin and PT were significantly higher in seropositive patients (all of Child A group), yet there was no significant correlation between ACI and serum enzymes not PT level in these patients.It may be concluded that, contrary to what may be expected of possible higher ACI in seropositive patients due to possible defect in natural calcification inhibitors, hepatitis C-seropositive prevalent hemodialysis patients may be at lower risk of aotic calcification.

Clinical Experiences

Role of NO on GIT Motility in Chronic Kidney Disease and Dialysis Patients

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Introduction: Gastrointestinal motor abnormalities may account for dyspeptic symptoms of chronic uremia patients. The gastrointestinal disorders possibly affect function and structure of the gastrointestinal tract and negatively impact on the nutritional status of the patients causing malnutrition, which is a major problem with end-stage renal disease (ESRD). Nitric oxide (NO) is a proven gut neurotransmitters and their receptors were identified in different parts of the GIT, especially the esophagus and stomach. In chronic renal failure (CRF), previous studies on NO and VIP showed different results whether decreased, increased or even not altered, and the role of NO and VIP on gastrointestinal tract in CRF was not evaluated. ***Patients and Methods:*** The study was carried out on 60 patients with chronic renal disease divided into 3 groups. Group 1 included 20 patients with CRF with creatinine clearance between 20 and 40 mL/min. Group 2 included 20 patients with ESRD (creatinine clearance <10 mL/min) just before the start of hemodialysis therapy. Group 3 included 20 patients on regular hemodialysis (HD). Control group (group 4) included 20 healthy subjects. For all groups, full history and clinical examination, routine laboratory investigations, creatinine clearance, serum nitrate levels an index of in vivo NO generation, esophageal manometry, and electrogastrogram were done. ***Results:*** There was a significant difference with serum nitrate between diseased CRF and healthy controls and in between patients groups. In the comparison between diseased CRF and healthy controls regarding dominant frequency, there is a highly significant difference, but no significant difference was found in between patients groups. In the patients with CRF, regarding diagnosis based on esophageal manometry and EGG: 16 patients was normal by esophageal manometry (26.7%), 21 patients with NSMD (35%), 5 with GERD (8.3%), 8 with DOS (13.3%), and 10 with esophageal aperistalsis (16.7%), this showed a highly significant difference in comparison with the control group. Thirty-four patients was normogastric by EGG (56.7%), 19 was bradygastric (31.7%), and 7 was tachygastric (11.7%), and also a highly significant difference in comparison to the control group. But in between the 3 CRF studied groups, no significant difference was found with regard to diagnosis based on both esophageal manometry and EGG. A highly significant, weak negative linear correlation between NO and DF. There is significant association between the manometric-based diagnosis, in CRF patients (3 groups), and NO. ***Conclusion:*** Serum NO is disturbed in ESRD whether those patients are on conservative medical management, or at the time of initiation of hemodialysis therapy or after maintaining regular hemodialysis therapy. The disturbed serum level of nitric oxide is associated with upper gastrointestinal dysmotility, which in turn may affect nutritional status of CRF patients and hence affects morbidity.

Are There Clinical Predictors of Nonobstructive Coronary Artery Disease Among Patients with End-Stage Renal Disease on Dialysis Referred for Coronary Angiography?

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Background: Cardiovascular diseases including hypertension and coronary artery disease (CAD) are extremely common and the leading cause of mortality in patients on dialysis. These patients also frequently have multiple other risk factors for CAD, including

dyslipidemia and diabetes. The National Kidney foundation recommends that all patients with chronic kidney disease should be deemed high risk for CAD. Despite this, some individuals appear to be relatively spared from severe obstructive CAD. We sought to examine whether there are clinical predictors of absence of obstructive CAD. ***Methods:*** We analyzed all patients with chronic kidney disease on dialysis referred for coronary angiography at a single hospital center. Age, sex, indication for cardiac catheterization, anemia, diabetes, smoking, dyslipidemia, and presence or absence of obstructive CAD (>50% stenosis in any of the epicardial coronary arteries) were evaluated. ***Results:*** Of 38 patients referred for coronary angiography, 15 had obstructive CAD and 23 did not. Patients without CAD were younger (53 vs. 65 years; P=0.018), more likely to be female (65% vs. 20%; P=0.0064), and less likely to have dyslipidemia (52% vs. 93%; P=0.0116). There was no significant difference between the 2 groups on anemia, use of aspirin, statin, erythropoietin, blood pressure, diabetes or indication for coronary angiography. However, patients without CAD were more likely to be referred for renal transplant evaluation. Average dialysis duration was similar between the 2 groups. Interestingly, among patients with elevated cardiac troponins, 36% of patients were found to have nonobstructive coronary disease. ***Limitations:*** Retrospective analysis of a small number of patients. ***Conclusion:*** Patients with end-stage renal disease on dialysis form a high-risk yet diverse population. Although it is difficult to predict which patients have nonobstructive disease, some clinical features such as age, gender, dyslipidemia, and indication for angiography may be helpful.

Influence of Satellite Hemodialysis On Modality Choice Among Aboriginal Incident Dialysis Patients

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Objective: To examine the influence that hemodialysis (HD) availability has on the choice of dialysis modality among Aboriginal Canadian incident dialysis patients. ***Methods:*** This is a retrospective study of Aboriginal patients starting dialysis in southeastern Ontario (SEO) and the James Bay Coastal area (JBC) in Northern Ontario. Peritoneal dialysis (PD) was the only modality available in JBC until 2006 when a HD unit was established in that region. Both modalities have been available in SEO all along. We compared the modality choice in 5-year periods before and after the opening of the JBC HD unit. ***Results:*** In both time periods most SEO patients chose HD. In 2000 to 2005 most JBC patients chose PD presumably to avoid relocation to SEO. Following the opening of the JBC HD unit about half of JBC patients still chose PD. For comparison, about 20% of nonaboriginal patients start PD at our center (Table 1). ***Conclusions:*** The results of this study suggest that when HD is made available in northern Communities, Aboriginal patients still favor PD. Given that JBC is a large and sparsely populated region, it is possible that geographic location still has a major influence on modality choice.

Table 1 Modality choice by region and time period

	Region	SEO		JBC	
Period	Modality	HD	PD	HD	PD
2000–2005	Choice	7	0	4	28
	Actual	7	0	13	19
2006–2010	Choice	7	1	12	14
	Actual	7	1	17	9

Syndrome of Rapid Onset End-Stage Renal Disease: A New Unrecognized Pattern of Progression of Chronic Kidney Disease to ESRD

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Background: By most accounts, there is an increasing worldwide end-stage renal disease (ESRD) epidemic. This ESRD epidemic persists despite over 2 decades of intensified reno-protection strategies including attempts at optimal hypertension management, optimization of diabetic control, smoking cessation efforts and the extensive application of RAAS blockade in both diabetic and nondiabetic chronic nephropathies. Current consensus and thoughts depend on a paradigm that chronic kidney disease (CKD) progression to ESRD is a continuous, progressive and predictable loss of eGFR in CKD patients, inexorably leading to ESRD. Our recent experience in a Mayo Health System Hypertension Clinic, as well as new reports associating ESRD development in CKD patients with episodes of acute kidney injury (AKI), led us to hypothesize that CKD to ESRD progression is not predictable, after all. ***Methods:*** The details of the 100-patient cohort have been recorded in our previous reports. We have continued to follow kidney function as measured by serum creatinine and MDRD eGFR, together with urine albumin creatinine ratio (mg/g), in our patients, at least every 3 months since recruitment. In July 2009, an 82-month prospective and very detailed patient-level data analysis was completed. Details are reported in the September 2010 issue of the journal *Renal Failure*. ***Results:*** Hundred patients were recruited into the cohort over the 30-month enrollment period. Overall, as previously noted in our past publications, eGFR had initially improved or otherwise remained stable, in most patients, following the discontinuation of the ACE inhibitor and/or the ARB. Subsequently, at analysis in July 2009, 17 (17%) patients had developed irreversible ESRD with need for maintenance dialysis. These 17 patients at enrollment had CKD stage III (2), stage IV (11), and stage V (4), respectively. In the last 24 months of follow-up, only 2 new patients had reached ESRD, both following cardiothoracic procedures. Age did not predict ESRD. Most pertinently, ESRD progression was unpredictable (by eGFR and/or CKD staging), and was preceded by AKI in 15/17 (88%) patients who progressed to ESRD. Acute kidney injury in the 15/17

patients resulted from hypotension/cardiogenic shock (7), sepsis (2), following cardiac surgery (2), malignant lymphoma (1), contrast nephropathy (1), obstructive uropathy (1), and dementia/failure to thrive (1). ***Conclusions:*** Among a 100 high-risk CKD patient cohort followed prospectively since 2002, we have demonstrated that in 15 of 17 (88%) patients who progressed to ESRD, CKD to ESRD progression was unpredictable, nonlinear, abrupt and rapid, and this followed AKI secondary to medical and surgical events. We have coined a new term, the syndrome of rapid onset end-stage renal disease to represent this previously unrecognized syndrome. Larger studies are warranted to confirm our single-center findings. If confirmed to represent a significant proportion of the ESRD population, at least here in the United States, this finding will demand major paradigm shifts in current concepts of reno-protection and A-V Fistula first programs.

Pruritus in Hemodialysis Patients

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Background: Pruritus is one of the most annoying symptoms in hemodialysis (HD) patients, which affects the quality of life and overall prognosis. The aims of this study were to evaluate the prevalence of pruritus in our chronic HD patients, and to correlate its presence and intensity with relevant clinical and laboratory parameters. ***Methods:*** One hundred thirty-one patients on maintenance HD in 2 out-patient HD units were enrolled in the study. A questionnaire was given to each patient to assess the intensity and frequency, as well as pruritus-related sleep disturbance. The relationship between clinical and laboratory data and the severity of pruritus were analyzed. ***Results:*** Pruritus was found in 62.6% of patients. In those with pruritus, the intensity of itching was mild with a visual analogue scale (VAS) score of <4.0, moderate (VAS 4.0–6.9) and severe (VAS ≥ 7.0), in 53.7%, 34.1% and 12.2%, respectively. The intensity of itching strongly correlated with the frequencies of skin scratching ($P<0.0001$) and of sleep disturbance ($P<0.0001$). There was no correlation between the occurrence of pruritus and demographic or clinical parameters (e.g., type of kidney disease, various comorbidities, and dialysis efficacy as expressed by urea reduction ratio) of the patients. History of parathyroidectomy tended to be more frequent in patients with pruritus, but this did not reach statistical significance ($P=0.091$). Treatment with antidepressants was more common in patients who had itch ($P<0.05$). There was a "U"-shaped relationship between the duration of HD and severity of itching. Interestingly, higher serum urea and lower vitamin B_{12} levels were significantly correlated with the presence ($P<0.01$ and $P<0.01$, respectively) and intensity ($P<0.01$ and $P<0.05$, respectively) of pruritus. ***Conclusions:*** Pruritus is still a common problem in patients undergoing HD and has a negative impact on the quality of sleep and mood. Our study is the first to suggest that low vitamin B_{12} levels could be a cause of pruritus in HD patients. We recommend measuring vitamin B_{12} level in patients with uremic pruritus, even if they do not have clinical manifestations of B_{12} deficiency.

Interleukin-18 Promoter Polymorphism and Development of Antibodies to Surface Antigen of Hepatitis B Virus

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Background: IL-18 is involved in hepatitis B virus (HBV) clearance and augments anti-surface antigen of hepatitis B virus (HBsAG) production during DNA vaccination. The *IL18* $-1297C>T$ (rs360719) polymorphism may modulate the *IL18* expression. ***Aim:*** To determine the potential association of *IL-18* $-1297C>T$ polymorphism with development of anti-HBsAg in HD patients. ***Methods:*** The frequency of *IL18* $-1297C>T$ alleles and genotypes was identified by polymerase chain reaction-restriction fragment length polymorphism in 347 hemodialysis patients. Group I (n=219) developed an anti-HBsAg titer >10 IU/L as a result of vaccination (patients with negative total antibodies to core antigen of HBV, anti-HBcAg, n=125) or as a result of HBV transmission (patients with total anti-HBcAg positive, n=94). Group II (n=128) included patients who did not develop an anti-HBsAg titer >10 IU/L in response to at least 1 full series of vaccination (patients with total anti-HBcAg negative, n=106) or HBV transmission (patients with total anti-HBcAg positive, n=22). The Hardy-Weinberg equilibrium was determined by the chi-square test. The significance of genotypes frequency was tested using the Fisher exact test. ***Results:*** The *IL-18* $-1297C$ allele frequency was detected in 27.1% and 24.2% of patients of groups I and II, respectively. The frequencies of $-1297CC$, $-1297CT$, and $-1297TT$ genotypes were 7.3%, 39.7%, and 53.0% in group I, respectively, and in group II were 1.6%, 45.3%, and 53.1%, respectively. There was no statistical deviation from the Hardy-Weinberg equilibrium in the genotype frequencies of group I ($\chi^2=0.003$), but it was for group II ($\chi^2=7.036$). The odds ratio (OR) for CC vs. CT+TT was 0.201 (95% CI=0.046–0.891, P=0.022) and OR for CC vs. TT was 0.213 (95% CI=0.048–0.956, P=0.036). ***Conclusion:*** In hemodialysis patients, *IL-18* $-1297CC$ genotype may play a role in anti-HBsAg development in response to HBV surface antigen. Patients bearing $-1297CC$ genotype may exhibit on average 5.0-fold increased chance of development of anti-HBsAg in response to vaccine HBV surface antigen or HBV infection.

Seasonal Variation in Number of Deaths Among Patients on Hemodialysis and Peritoneal Dialysis

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Background: Cardiovascular disease accounts for $>50\%$ of deaths in dialysis patients. The expected rate of attrition is ex-

pected to be uniform throughout the year. We had anecdotal reports of a rise in deaths among our hemodialysis patients during winter months. Two years ago we analyzed mortality over 4 years among established hemodialysis patients and found increased mortality in autumn/winter months. ***Objective:*** We aimed to explore if the same variation is seen in mortality among patients on peritoneal dialysis as well, and compare seasonal mortality with patients on hemodialysis. ***Methods:*** We analyzed data on our hemo and peritoneal dialysis population between January 1, 2004 and March 31, 2010. Date of death was collected for all patients. Seasons were defined by months as follows: spring (March–May), summer (June–August), autumn (September–November), and winter (December–February). ***Results:*** Total number of deaths between April 4 2004 to March 31, 2010. Peritoneal dialysis patients—67, hemodialysis patients—636. ***Conclusion:*** Although there is increased rate of mortality in hemodialysis patients in autumn and winter months, the same is not seen in patients on peritoneal dialysis. Knowing that cardiovascular disease is main culprit in mortality among dialysis population, this variation is difficult to explain. There are small studies that indicate higher cardiovascular mortality in nondialysis population, attributing that to low vitamin D levels and increased blood pressure, but even that fails to explain contrast among hemodialysis and peritoneal dialysis patients. This study has stimulated investigation, which might help us to identify a vulnerable subpopulation of hemodialysis patients and to increase surveillance during these months.

Metformin Intoxication Requiring Dialysis

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Background: Metformin (MTF) is one the most common oral agents used to treat diabetes mellitus. Intoxication is associated with lactic acidosis and has significant clinical consequences. We report 12 cases requiring dialytic intervention. ***Methods:*** Twelve patients from 2005 to 2010, 10 treated with dialysis. Conventional HD and continuous venovenous hemodialysis treatments with bicarbonate dialysate results as mean and SD. ***Results:*** Twenty-five percent mortality, 33% male patients, hospital stay 9.3(12) days, average MTF dose 1.7 g/d. Base glomerular filtration rate 51.5 mL/min, age 64 (11) years. On presentation all had acute kidney injury with BUN/creatinine 75 (30)/8.1 (3.7) mg/dL, Lactic acid 12.4 (8.1) mmol/L, pH 7.04 (0.19) bicarbonate 7.2 (4.5) mmol/L, MTF level 25 (17) mcg/mL, AGap 28 (9) serum K 5.4 (1.3) mEq/L. Seventy percent were treated with conventional HD. Patients required 4 (5) dialysis treatments at blood flow QB 330 (53), dialysate flow QD 571 (111) for 305 (122) minutes. Postdialysis treatment the acidosis corrected ($P < 0.05$): bicarbonate 19.2(4.1) mmol/L lactic acid 6 (4) mmol/L and MTF level decrease 8.9 (5.7) mcg/mL MTF percent removal of 60 (24). No difference between HD and continuous venovenous hemodialysis. Only difference between survivors was age 53 (7)vs. 78 (10) $P < 0.05$. ***Conclusion:*** Metformin toxicity is a serious clinical condition, causes severe lactic acidosis with significant mortality. Hemodialysis is an efficient method to treat MTF intoxication and correct the metabolic abnormalities.

	n	Mean	SD
Age	12	64.00	11.43
Met dose	12	1791.7	396.5
GFR baseline	7	51.571	34.91
BUN1	12	75.42	30.61
Creat1	12	8.1500	3.733
AG	12	28.25	9.799
HCO_3 before hd	9	7.222	4.549
HCO_3 after	8	19.250	4.132
Lactic pre	12	12.492	8.177
Lactic post	9	6.078	4.923
pH pre	9	7.0444	0.1918
pH post	8	7.4213	0.0683
Gluco pH pre	12	25.000	17.41
Gluco pH post	8	8.913	5.701
Mtf removal per c	8	60.026	24.97

Is Warfarin More Harmful than Beneficial in Hemodialysis Patients?

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Purpose: The aim of this study was to carry out a retrospective analysis of the use of warfarin treatment in our hemodialysis (HD) patients with atrial fibrillation (AF); AF is the commonest arrhythmia in this group, but there are only a few retrospective studies and no clinical trial. ***Method:*** Proton database was used to identify all HD patients who developed AF between January 2005 and December 2009; patients were divided into those who received warfarin or aspirin or declined either. Complications and outcomes were compared in the first 2 groups. ***Results:*** Out of 445 patients starting maintenance HD during study period, 48 (10.8%) developed confirmed AF; 20 started treatment with warfarin with regular INR monitoring (1.5–3) and 26 received aspirin 75 mg daily. Two patients who refused either were excluded from analysis. Mean age, comorbidity scores (UK renal registry criteria) and outcome are shown in Table 1. Warfarin was stopped in 5 (25%) because of hemorrhagic complications and discontinued in 4 (20%) in whom warfarin was later thought to be unsafe (frequent falls, age, etc.). Nonfatal stroke and death was similar in both groups; 1 patient in each group died of bleeding complications. ***Conclusions:*** The benefits of oral anticoagulation in HD patients with AF must be carefully weighed against bleeding complications and possible increase in vascular calcification from vitamin K deficiency. Lifelong anticoagulation is recommended in high-risk nonrenal patients with AF but extrapolation of these guidelines to dialysis patients may not be appropriate. In our study only 55% of patients started on warfarin could continue it and 18% (2 out of 11) continuing warfarin still

had thrombotic stroke. Benefit of long-term warfarin treatment in HD patients with AF can only be evaluated in large controlled studies. Until then warfarin must be used with caution in this group.

Table 1

	Aspirin	Warfarin
Total patients	26 (56.5%)	20 (43.5%)
Mean age (y)	74 ± 12.5	74 ± 7.8
Comorbidity score	1.6 ± 1.3	1.8 ± 1.6
Continued treatment	26 (100%)	11 (55%)
Stopped due to hemorrhage	0	5 (25%)
Stopped to avoid hemorrhage	0	4 (20%)
Thrombotic stroke	4 (15.4%)	2 (18.1%)

Integrating the Art and Science of Patient Care: Assessing the Role of Creative Expression for Hemodialysis Patients

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Objectives: This qualitative pilot study was designed to explore the perceived influence of creative activities on patients during long-term hemodialysis (HD) care. ***Methods:*** Nine individuals consented to participate and completed the project: 2 men, 7 women; ages 39 to 86; 5 African Americans, 4 European Americans. Participants were randomly assigned to the intervention group (N=5) and control (N=4). The intervention group received art-making materials and project ideas, developed in collaboration with the Carnegie Museum of Art in Pittsburgh, PA, over 3 HD sessions. The control group received new magazines of their choice. In-depth interviews were conducted with each participant to assess the impact of the intervention upon the experience of dialysis. Qualitative data were transcribed verbatim, coded, and thematic analysis conducted. ***Results:*** Participants in both groups reported the positive influence of power of choice, of material or topic, given to them. The majority of participants in both groups enjoyed the project as an alternative way to occupy their time during HD. Half of the control group reported a desire to participate in the art group. The intervention group participants shared more about their life outside of HD and about the arts intervention as a way to bridge their lives and their time-consuming, physically constraining treatment regimen. The intervention group participants also shared about their artwork and its production as a process of problem solving and reflection. For all these reasons, 8 out of 9 participants were enthusiastic about participating in art making during future HD sessions. ***Conclusion:*** This pilot study supports at least a larger study comparing multiple clinics that employs a more generalizable quantitative measure of quality of life during HD. According to the results of this study, the HD patient population could benefit from arts-based programs that provide a chance to reflect in a structured manner and give them a sense of choice and control over the way they spend their time in the dialysis chair.

Daily Hemofiltration, a Useful Therapy in the Treatment of Cardiac Complications with Digoxin Toxicity in a Patient with Anuric Acute Kidney Injury

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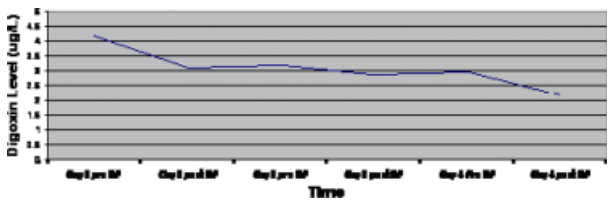
Introduction: Patients with severe renal failure are at increased risk of life threatening digoxin toxicity, as it is excreted by the kidney. The major reservoir of digoxin is skeletal muscle and only 15% to 20% is protein bound in serum. Various treatment has been adopted including hemoperfusion (HP), Digoxin-specific antibody fragments (Digibind) and plasma exchange (PE) with limited success. We report a case of successful management of Digitalis toxicity with anuric acute kidney injury (AKI) and cardiac complication treated with hemofiltration (HF). ***Case Description:*** A 77-year-old male was presented with anuric AKI due to dehydration, nephrotoxic medications, and digoxin toxicity. His biochemical profile showed Urea 36.8 mmol/L, serum creatinine 654 mmol/L, potassium level of 4.7 mmol/L, and digoxin level of 4.1 ug/L. ECG revealed junctional rhythm with variable heart block due to digitalis effect. His renal function deteriorated rapidly with uremic symptoms and marked bradycardia (HR 35 bpm). Digibind was not given as his BP was stable and the possibility of potential rebound of free digoxin causing severe toxicity. He had daily HF and his HR gradually improved with slow reduction of serum digoxin level (see Picture 1). His renal function recovered and did not require further HF after day 4. ***Discussion:*** The current treatment strategy for digoxin toxicity in renal failure includes HP with resin, charcoal and specific columns of β2-microglobulin adsorption, activated charcoal intestinal dialysis, digibind, PE and peritoneal dialysis. All the above treatments have variable limited success in digoxin toxicity. In situation where there is cardiac destabilization of a patient with digoxin toxicity and anuric AKI, HF can be a useful treatment to stabilize patient by clearing the free digoxin from the circulation and allowing gradual reduction of serum digoxin from critical high level. ***Conclusion:*** Daily HF is a useful therapy in the treatment of digoxin toxicity with cardiac complications in a patient with anuric AKI. Our case may be beneficial to nephrologists faced with this clinical scenario in the future. Picture 1: Digoxin level with successive HF treatment.



Improved Hemodialysis: A Necessity

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Seventy-five percent of end-stage renal disease patients are depending on chronic dialysis for their survival. 25% are alive after 5 years. Functional status is of interest among chronic hemodialysis (HD) patients.
Methods: Out of 37 HD patients, 26 were suitable for investigation with the Dartmouth COOP charts. Mean age was 68 years. Mean time on HD was 37 months. Charts were also given to the nurses in charge. ***Results:*** Each of the 9 dimensions in the charts was graded from 0 to 5 points, the latter meant bad status. Physical performance was low among 73% of the patients. The overall health dimension was low among 62% of the patients. Pain was perceived to be severe in 35% of the patients. Only 4 patients answered that they had been bothered emotionally during the last 2 weeks. The nurses estimations coincided well with most of the patients' 9 COOP dimensions. The nurses overestimated the emotional problems and the overall health status. They underestimated the patients' pain and social support. ***Discussion:*** Several factors influence the depressing results, e.g. high age, comorbidities, length of dialysis. To improve survival the dialysis treatment has to be longer and more frequent as well as increased physical activity and better education of the patient. ***Conclusion:*** The simple COOP enquiry demonstrated clearly the deficiency of inadequate HD.

The Experience of Being on Dialysis Among the Elderly

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Background: People over 75 years of age are the fastest-growing population of patients with chronic kidney disease Stage 5 who are currently initiating dialysis. Despite this rapid growth in the prevalence of chronic kidney disease in the elderly, little is known about how dialysis affects these patients. Age alone does not measure a person's ability to survive and benefit from dialysis. Thus, obtaining more information on how the elderly experience life after initiating dialysis is important in order to guide physicians, patients, and families in their decisions regarding initiating and living with dialysis. ***Methods:*** This was a qualitative study that used a semistructured interview schedule centered on the following categories: initiating dialysis, patient education, physical condition, social and psychological support, experience of dialysis, and the coordination of care including the coordination between the nephrologist and the primary care physician. A total of forty patients between the ages of 75 and 88 were interviewed in 5 chronic dialysis care facilities located in the Midwest. Twenty-one females and 19 males were interviewed with the range of time that they had been on dialysis varying from 2 months to 13 years. Interviews were transcribed and then analyzed in each of the categories to identify common patterns and key themes about the patients' experiences of dialysis. ***Results:*** Preliminary results distinguish 4 key themes. (1) Decisions about initiating and staying on dialysis are often difficult for elderly patients. There was a wide range of experiences. (2) Elderly patients who have better support either from family, friends (including other patients) and dialysis staff were more likely to have a positive experience. (3) The atmosphere of the dialysis facility and the quality of interactions between patients and patients and staff significantly affected the elderly patients' positive or negative experience of dialysis. (4) The role of the primary care physician was key in initial education and guidance about dialysis. ***Conclusions:*** Both providers and aging patients would benefit from improved descriptions and understanding of the experiences and quality of life of very elderly dialysis patients.

Difference of Postdialysis Extracellular Water to Total Body Water Ratios Between Arms May be Useful for Early Detection of Central Vein Stenosis

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Extracellular water (ECW) to total body water (TBW) ratio using bioelectrical impedance analysis (BIA) by InBody (Biospace, Korea) is 0.380 in healthy persons. We use the postdialysis ECW/TBW ratio to assess dry weight in hemodialysis (HD) patients. Central vein stenosis (CVS) is sometimes noted after swelling and edema have appeared. Duplex venous ultrasound is the only noninvasive detection method. We found BIA useful for CVS detection. A 47-year-old woman with 22 years HD developed swelling on the left and visibly dilated vein in the shoulder. Scar below the left subclavian was noted. Duplex venous ultrasound could not locate the stenosis. Venogram of the left arteriovenous fistula (AVF) showed severe occlusion of the left subclavian vein with dilated collateral veins in neck and shoulder. Surgery was performed for AVF occlusion and formation of a new right-side AVF. A retrospective data check including BIA showed postdialysis ECW/TBW of the left upper limb to be 0.398 and 0.367 on the right. After occlusion, ECF/TBW decreased to 0.378 on the left and remained at 0.366 on the right. This case illustrated the difference between arms as an early marker for CVS detection. With a 0.027 difference in this case, we examined a difference of over 0.020 in the ECF/TBW ratio in maintenance HD patients. Hundred ten patients (male 68, female 42, mean age: 65.9 $\pm$ 12.3 years old, dialysis vintage: 7.4 $\pm$ 7.1 years) were surveyed postdialysis using a body composition analyzer. A 61-year-old woman had an ECF/TBW ratio of 0.389 in the left arm with AVF and 0.368 in right arm. No swelling or edema was noted. Arteriovenous fistula venogram showed moderate-to-severe stenosis of left innominate vein. Angioplasty was performed. Postdialysis ECF/TBW ratio decreased to 0.384 after surgery. Postdialysis ECF/TBW ratio may be useful for CVS detection before clinical manifesta-

tions such as edema or swelling emerge. Further studies and reconsideration of more sensitive postdialysis ECF/TBW ratio for detection of early stage CVS are warranted.

Dialytic Therapy for Idiopathic Hyperammonemia Following Lung Transplantation: A Case Report

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Idiopathic hyperammonemia (IHA) is a rare but often fatal condition characterized by abrupt alterations in mental status and markedly elevated ammonia levels in the absence of any identifiable cause. It has been described following lung transplantation, bone marrow transplantation, and high-dose chemotherapy. Successful treatment depends on the early initiation of multimodality treatment to rapidly reduce ammonia levels. Dialysis is an effective therapy to enhance ammonia clearance, which is dependent on the blood flow rate (BFR), dialysate flow rate (DFR), and dialyzer surface area; however, the optimum dialysis modality in the setting of IHA is unknown. We report the case of a 69-year-old woman who developed hyperammonemia a few days following bilateral lung transplantation. Her postoperative course was complicated by prolonged mechanical ventilation and vasopressor support. On postop day 6, she developed altered mental status and was found to have an ammonia level of 305 μmol/L in the absence of liver dysfunction. Her ammonia level peaked at 413 μmol/L complicated by seizures and evidence of increased intracranial pressure. As an adjunct to other measures to reduce her ammonia level, she was started on continuous venovenous hemodiafiltration using a BFR of 180 mL/min, DFR of 2500 mL/h, and replacement fluid at 2000 mL/h. The next day, her ammonia level remained elevated at 301 μmol/L, and intermittent hemodialysis (IHD) was added with maximal BFR and DFR with a reduction in her ammonia level to 90 μmol/L after 4 hours and 76 μmol/L after 6 hours. She was continued on a combination of IHD and continuous venovenous hemodiafiltration with maintenance of her ammonia level below 200 μmol/L. Despite aggressive therapy, the patient died on postoperative day 11 from complications of IHA. High-efficiency IHD is the most effective dialysis modality to rapidly reduce ammonia levels, but it must be instituted early in the course of IHA before significant neurologic complications occur. Repeated sessions are usually needed because of residual or rebound hyperammonemia. Continuous renal replacement therapy can be used to maintain ammonia levels between IHD sessions.

Efficacy of Enalapril and Sustained-Release Nifedipine in Controlling Blood Pressure of Patients on Maintenance Hemodialysis: Observations from Ongoing EDIT Trial

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Objective and Purpose: Control of blood pressure (BP) is a major issue in maintenance hemodialysis (MHD) patients. Different types of antihypertensives are being used but selections regarding optimum ones are still debated. In this study the efficacy of ACE inhibitor Enalapril (E) in comparison to slow release Nifedipine (N) on reduction of BP in MHD patients was observed. ***Method:*** This was a prospective, randomized, parallel group and open label study. Patients of MHD having predialysis BP > 140/90 mmHg despite existing antihypertensive medications were included in 2 groups. Alternate patients were given either Enalapril (group E) or sustained-release Nifedipine (group N). In E group Enalapril was started with 10 mg once daily and in N group Nifedipine sustained-release formulation 20 mg (phase 1). The phase 1 dose was increased after 4 weeks to 10 mg twice in E and 20 mg twice in N group if BP is not lowered to $\leq$ 140/90 mmHg (phase 2). After another 4 wks if BP is still not in target range (< 140/90) additionally nifedipine, up to 20 mg, was added to both E/N groups as required (phase 3). ***Results:*** Finally analyzed subjects of both the E (n = 17) and N (n = 20) groups were matched at recruitment for age (49 ± 13 vs. 44 ± 15 years); duration of hypertension (9 ± 6 vs. 6 ± 5 years); duration of dialysis (8 ± 9 vs. 10 ± 10 months) and residual urine volume (0.4 ± 0.3 vs. 0.5 ± 0.4 L/d). They were mostly dialyzed twice/wk with a Kt/V_{ureea} of 0.8 ± 0.3 vs. 0.7 ± 0.3 per session and ultra filtration rate 2.6 ± 0.6 vs. 2.7 ± 0.7 L per session; (P = NS). Similar number of subjects in 2 groups were on erythropoietin (41% vs. 55%, P = NS). In both groups at the starting of the study, antihypertensive medication atenolol was taken by 65% vs. 55% (P = NS), amlodipine 76% vs. 47% (P < 02); prazosin 56% vs. 60% (P = NS), furosemide 58% vs. 51% (P = NS). Only 16% were on any ACEI drugs and 8% on ARBs. The base line pretrial systolic and diastolic BP in E and N group, respectively, was 158 ± 16 vs.163 ± 17 and 88 ± 10 vs. 93 ± 12, mmHg (P = NS). At the end of phase 1 drug, 33% vs. 50% (P = NS) was nonresponder in E vs. N group having systolic and diastolic BP 167 ± 19 vs.165 ± 18 & 98 ± 7 vs. 91 ± 16 (P = NS). After doubling the dose at phase 2 in both the groups, 29% vs. 35% (P = NS) remained nonresponder with the BP of 168 ± 16 vs.161 ± 16 and BP 89 ± 6 vs. 88 ± 12 mmHg (P = NS). When at phase 3 additional dose of Nifedipine (22 ± 13 vs. 15 ± 10 mg) was added to all nonresponder subjects of phase 2 (n = 20), the BP was still uncontrolled in 15% vs. 20% (n = 7). While in the responders of E group (n = 6) this came down to (systolic and diastolic BP, mmHg) 171 ± 10 vs.132 ± 8 (P < 0.001) and 93 ± 5 vs. 77 ± 8 (P < 0.004); and similar of N group (n = 7) to 162 ± 11 vs.131 ± 7 (P < 0.001) and 92 ± 11 vs. 80 ± 2 (P < 0.03). As a whole target BP (< 140/90) was achieved in 17% at phase 1, 36% in phase 2, and 65% at phase 3. ***Conclusion:*** It may be concluded that Enalapril and Nifedipine, separately with usual doses, are not adequate in reducing blood pressure as an additional antihypertensive for majority of maintenance hemodialysis patients. By adding at a higher dose,

Nifedipine may reduce blood pressure more significantly in resistant hypertensive subjects.

Dialysis Systems, Equipment

Monitoring and Improving the Quality of Water in Portable Reverse Osmosis Machines

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Background: It is important to monitor microbial contamination of water used in hemodialysis machines in order to provide safe and effective hemodialysis. Regulatory agencies, such as the Centers for Disease control and prevention and the Association for the Advancement of Medical Instrumentation, have established allowable upper limits of microbial contamination of water. During routine monitoring of water in the dialysis unit, we noted bacterial counts above the allowable limits on the portable reverse osmosis machines. ***Objective:*** In order to identify potential causes of the elevated microbial counts, a Root Cause Analysis was conducted by an interdisciplinary team consisting of representatives from Dialysis, Infection control, Bio-medical engineering, and Facilities Management. ***Methods:*** A review of water cultures for the past year revealed a consistent increase in the level of microbial counts from the portable reverse osmosis machines. There was no increase in the number of health care associated infections in hemodialysis patients during this time period. The entire process for monitoring and maintaining the quality of water in the dialysis machines was flowcharted. An aggressive staff education program was undertaken. In order to eliminate variance and improve accuracy, 1 person and an alternate were trained and assigned the task for collecting the water cultures. The daily log for documenting results of water cultures was revised to ensure appropriate follow-up. A database was created for tracking water cultures. Those requiring actions were highlighted in yellow or red depending upon the microbial count. The database also includes the dates of cleaning and disinfection of the central water system and dialysis machines. The data were reviewed by the Hospital Dialysis Unit Governing body and the Infection Control Committee. ***Results:*** The efforts of this interdisciplinary team resulted in significant reduction in microbial contamination of water in the dialysis unit. Water cultures from the portable reverse osmosis machines that exceeded the allowable level were reduced from 48% to 2% after process changes. ***Conclusions:*** The process changes and ongoing feedback of information from infection control to the interdisciplinary team made positive impact on our water culture surveillance program and served as a basis for implementing a process structure that ensures adherence.

Development of Intermittent Infusion Hemodialysis Using Ultrapure Dialysis Fluid by an Automated Dialysis Machine

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In a typical hemodialysis (HD) treatment, excessive water removal often induces hypotension and muscle spasm. Intermittent infusion hemodialysis (IIHD) using ultrapure dialysis fluid produced by an automated dialysis machine, GC-110N (JMS Co. Ltd, Tokyo, Japan) was newly developed. The IIHD may therefore transiently improve the peripheral circulation by repeated intermittent infusion. A multicenter clinical trial was carried out to evaluate the clinical effectiveness of the IIHD therapy in comparison with standard HD (SHD). We enrolled 20 chronic renal disease patients were participated in this crossover study of the IIHD and SHD. The IIHD includes the intermittent rapid infusion of 200 to 300 mL of ultrapure dialysis fluid at a rate of 100 mL/min 7 to 10 times per treatment. The values of removal rate, solute clearance, and cleared space (CS) for urea, creatinine, uric acid, inorganic phosphate, b_2-microglobulin, and a_1-microglobulin were compared between the IIHD and the SHD therapies. Time course of blood volume (BV) and peripheral blood flow rate of the patient were measured continuously by a hematocrit monitor and a laser flowmeter, respectively. As a result, increases of BV and peripheral blood flow rate were observed for each infusion in all patients. Time-averaged BV reduction during a treatment was significantly lower in the IIHD than that in the SHD, in spite of identical water removal amount. Although no significant difference between the IIHD and the SHD therapies was obtained for removal rate in all solutes, the averaged values of CS in the IIHD was higher than those in SHD for all solutes. In particular, IIHD had significantly higher CS values for inorganic phosphate and a $_1$-microglobulin than the SHD. Improvement of peripheral circulation due to intermittent infusion might be increased in water and solute transport from the extravascular to intravascular compartments.

Solar-Powered Hemodialysis

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Introduction: As 35 of our 114 hemodialysis (HD) patients currently self-dialyze on paired Fresenius 4008B+Aquauno reverse osmosis (R/O) systems at home (HHD), their power costs mount despite a state of Victoria prorata reimbursement for utilities of A$1450/patient/y. As a first step toward a patient+program "partnership" to install solar power for HD in the home as a further

incentive for HHD, we report a pilot project to fully solar power our HHD training facility. This is the first known, reported solar powered dialysis facility in the world. ***Method:*** Eighteen Conergy P170 M solar panels (panel weight 306 kg: panel area = 23.409 m^2: predicted power output [historical means] = 4.58 kW h/m^2/d/y) and a Conergy inverter (total equipment + installation cost-A$16,219) were installed at our 4 chair, 4 operating d/wk HHD training facility. All generated solar power feeds into and is reimbursed from the state grid. Our HD + R/O systems have been circuit isolated and group metered to record all grid-drawn dialysis-related power and all system operating time is metered. The system "went live" in July 2010. ***Results:*** In the first 49 operational days (July–September = Australian winter), 13.35 kW h/d/wk has been generated while all 4 × HD systems have drawn 14.5 kW h/d/wk in 19.79 h/d. The historical expected annualized solar exposure (SE) is 4.58 kW h/m^2/d while the historical mean SE (July–September) is 3.4 kW h/m^2/d, 74% of the expected annualized SE. Despite a winter start, our system is already providing 91.5% of all required power. Using both historical SE and actual draw data, full-cost repayment via grid reimbursement can be predicted within the first 8 years. As estimated panel life is 25 to 30 years, free power and a future income stream should accrue beyond the first decade. ***Conclusion:*** While a full 12-month assessment is clearly needed to confirm the sustainability of this encouraging start, we believe that solar powered dialysis may prove to be practical, cost effective and environmentally responsible for both facilities and HHD alike. The development of shared-cost patient + program installation agreements may add an extra incentive to our already successful HHD program.

Role of Adsorption in Dialyzers for Continuous Renal Replacement Therapy

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Objectives: Continuous renal replacement therapy (CRRT) is usually performed under limited amount of dialysis fluid. Furthermore, better clinical outcomes in CRRT have been reported with dialyzers with high-adsorption characteristics than that with high solute permeabilities. The aim of this study is to evaluate solute removal performances of commercial dialyzers for CRRT in vitro in terms of adsorption characteristics of the membrane. ***Materials and Methods:*** Materials of the membrane were polyester polymer alloy (PEPA) and that with hydrophilic agent (Nikkiso Co., Tokyo, Japan), polymethylmethacrylate (PMMA), and polysulfone (Toray Co., Tokyo, Japan). Ultrafiltration experiments with aqueous test solution were performed at 310 k under Q_B = 100 mL/min, Q_F = 1000 mL/h. One of the following substances was chosen as a test solute in each experiment, i.e., creatinine (MW113), vitamin B_{12} (MW1355), or chymotripsin (MW25400). ***Results and Discussion:*** Exactly the same sieving coefficients were found in 4 dialyzers over time in creatinine, which implied there were no adsorption characteristics in these membranes to creatinine. In the case of vitamin B_{12}, however, higher clearances were found with a PEPA dialyzer (about 1.6 times) for the first 10 minutes after starting the experiment than those of other 3 dialyzers. Additionally, PMMA and PEPA membrane dialyzers showed significantly high clearances for chymotripsin compared with other 2 membranes. The initial clearance was about 2 times and 4 times higher in PMMA and in PEPA, respectively, than that in polysulfone (16.7 mL/min) with no adsorption. Polyester polymer alloy may have the same or even greater adsorption characteristics to PMMA that has been known to have excellent performance in removing mediators in CRRT. ***Conclusions:*** Adsorption characteristics are useful in CRRT, especially for removing middle or large molecules, and, PMMA and PEPA membrane have excellent adsorption characteristics.

Assessment of a Device to Detect Venous Needle Dislodgement

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Background: Although venous pressure monitoring is currently standard practice to detect venous needle dislodgement (VND) it is not always effective. Additional protection is often required using devices intended to detect blood loss to the environment. ***Objective:*** In the first phase of the study we assessed the use of a device to detect VND (Redsense Medical, Halmstad, Sweden). During the second phase, following improvement work by the manufacturer the device was re-evaluated. ***Method:*** Training was provided by the manufacturer and equipment to enable 100 treatments was supplied. On completion of all treatments nurses were asked to complete a questionnaire. This included some questions regarding the use of the device, followed by a set of statements where each respondent was asked to express their level of agreement using a Likert scale. During the second phase retraining was provided by the manufacturer and equipment to enable 100 treatments was supplied. Staff and patients were asked to complete a questionnaire at the end of each treatment. On completion of all treatments nurses were asked to give feedback using a modified version of the questionnaire used in phase 1. ***Results:*** Hundred percent of respondents in both phases of the study agreed that the device was easy to use. In phase 1, 9 nurses completed the questionnaire. There was a level of agreement of 3.5 that the device did not always work as expected. Some of the findings indicated false alarms and others no alarm when oozing occurred. In phase 2, 70 end of treatment questionnaires were completed; 13 patients and 13 nurses gave feedback. On completion of the study 8 nurses completed the modified (phase 1) questionnaire. No occurrences of VND were

recorded during the study period. There were no occurrences of false alarms. 62.5% of nurses reported that the alarm unit was improved from the first evaluation, 25% were not sure and 1 nurse (12.5%) had not been involved in the initial evaluation. Ninety-four percent of nurses believed the use of the device improves monitoring during hemodialysis and 91% of patients responded that it improved safety. Despite this 100% of nurses either disagreed or strongly disagreed that the device should absolutely be used for all patients. However, 85% believed that the device should absolutely be used for certain patients. ***Conclusions:*** The nurses found the device easy to use. The results from phase 2 indicate that the problems identified in phase 1 have been resolved. The nurses in this study reported that the device improved monitoring during treatment. Although they did not feel the device would be necessary for all patients they did believe that it was necessary for certain patients. The clinic is simultaneously evaluating an assessment tool to identify patients at increased risk of VND.

Time Course of Internal Filtration Properties of a High-Flux Dialyzer

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Objective: Performance of a high-flux dialyzer depends on internal filtration (IF) in addition to diffusive transport. It is, however, hard to evaluate IF property exactly. The objective of the present study is to evaluate the time course of IF properties of high-flux dialyzers and also to clarify the time-dependency of membrane fouling caused by IF. ***Materials and Methods:*** In vitro dialysis experiments were performed using commercially available high-flux dialyzers; APS-15SA, APS-15E, and APS-15EX for 4 h. two liters of bovine blood with 30% of HCT and 6.5 g/dL of TP were circulated at 200 mL/min to the test dialyzers. On the other hand, a phosphate buffer solution was fed to the dialysis fluid side of the dialyzers at 500 mL/min. Net filtration rate Q_F was set to 0 mL/min. The time course of IF rate (Q_{IF}) was measured by observing a blood velocity profile along the dialyzer by the Doppler ultrasonography. To evaluate time dependency of the membrane fouling property, analytical solution of the newly introduced theoretical model for flow and pressure profiles of the dialyzer was fitted to the data on the time course of local Q_B profiles along the dialyzer. ***Results:*** The IF rates gradually decreased with time, and these values at 15 and 240 minutes were 20 and 11 mL/min for APS-15SA, 53 and 47 mL/min for APS-15E, and 59 and 49 mL/min for APS-15EX, respectively. ***Discussion:*** These decline tendencies are due to membrane fouling greatly depending on total filtration volume. Numerically analyzed Q_B profiles had a good agreement with experimental data at 15 min. However, at the blood inlet of the dialyzer, a difference between theoretical and experimental Q_B values was slightly greater than that at the other parts in the dialyzer. Greater membrane fouling may occur particularly at the blood inlet when IF rate is raised. ***Conclusions:*** The time course of IF properties can be evaluated by the Doppler ultrasonography. Excessive IF enhancement may decrease membrane permeability due to accelerated membrane fouling particularly at the blood inlet. Hemodialysis treatments using high-flux dialyzers, therefore, have an advantage of increasing solute removal efficiency by enhanced convective transport and simultaneously a disadvantage of decreasing solute removal efficiency by membrane fouling.

Use of Sorbent Dialysis for the Removal of Contaminants from Potable Tap Water to Produce ANSI/AAMI Quality Dialysate

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Resurging interest in sorbent dialysis is due largely to its capability of reducing the water required for patient treatment from approximately 120 L of RO water to 6 L of potable tap water. This dramatic reduction in both the volume of water and the expense associated with producing RO quality water is garnering worldwide attention as the leading alternative to the typical single-pass dialysis treatment. The purpose of this study was to determine whether the HISORB+^{TM} sorbent cartridge could produce ANSI/AAMI quality water for dialysate from water that has been spiked to contain the US EPA indicated potable water maximum allowable contaminant limit (MACL) for the specific chemicals listed in ANSI/AAMI RD62:2001. The results indicate that all of the metallic inorganic contaminants and fluoride are removed from the system after 30 minutes of dialysate circulation to levels below ANSI/AAMI MACL; this includes removal of contaminants from any dilution water used to control conductivity up to that point. The oxoanions sulfate and nitrate, however, did not show any appreciable reduction from initial levels. This result was expected as the cartridge is not designed to remove these species from dialysate. It is inevitable with the use of tap water that chemical species will be encountered, which may not be removed from the dialysate by the sorbent cartridge. These instances highlight the value of volume reduction: for example, a typical single-pass dialysis treatment using 120 L of water with sulfate at the ANSI/AAMI MACL of 100 mg/L would expose the patient to a maximum mass of 12 g of sulfate. In comparison, a typical sorbent dialysis treatment using 6 L of water at the EPA MACL of 250 mg/L would expose the patient to a maximum mass of 1.5 g of sulfate, or 8 times less of the contaminant. In conclusion, the HISORB+^{TM} sorbent cartridge effectively reduces the potential exposure of chemical contaminants found in potable water to the patient by directly removing the species from the dialysate and by drastically reducing the volume of dialysate required for the treatment. Additional studies will include an investigation of the sorbent cartridge performance with source water from locations where the water quality is known to be poor.

CROWNWeb Phase III and the 2011 National Release: The Road Ahead

Matthew McDonough. FMQAI—The Florida ESRD Network, Tampa, Florida, USA

CMS recently announced plans to release the third phase of its CROWNWeb data-collection system, to be used by end-stage renal disease dialysis organizations, in January 2011, and expects to roll out the full-national release in late Spring 2011. What users can expect include:*Phase III Overview*

1. Begins Q1 2011
2. Twenty facilities in each Network—Expands number of participating facilities from 180 to ~360
    1. Split approximately 50/50 between large dialysis organizations (Batch Submitting Organizations) and smaller groups and independents
1. Batch data submission still being refined
    1. BSOs will continue to submit 100% of patient population into CROWNWeb via batch testing
1. User accounts will be managed through new QualityNet Identity Management System (QIMS)
2. Phase III includes Multifactor Authentication (MFA) security system
3. Changes to Graphical User Interface in:
    1. Section 508 compliance
    2. Data masking
    3. Clarification of fields/error messages.

2011 National Release

- Expected launch in late Spring 2011 with 100% of facilities submitting data
- Submission still accomplished via manual entry and EDI
- QIPS retired—only QIMS system available.

Education, Quality Improvement

Health-Related Quality of Life and Psychiatric Illness after Kidney Transplantation in Comparison to Hemodialysis: Variables that Influence Them

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Introduction: The relevance of quality-of-life (QOL) indications is derived not only because QOL is a basic aspect of health, but also a close relationship exists between QOL, morbidity, and mortality. The purpose of this study to evaluate and compare the effect of hemodialysis (HD) and transplantation on QOL, psychiatric illness, and to explore the variables affecting it using WHOQOL-100 and General Health Questionnaires. ***Methods:*** In this cross-sectional study, QOL and psychiatric illness were analyzed in 80 renal transplant recipients compared with 80 HD patients. Both questionnaires were administered as a self-completed questionnaire to all participants and all studied subjects were asked to estimate their subjective QOL and psychiatric illness by answering questionnaires. ***Results:*** Quality of life of the renal transplant patients is better than HD group. As regard psychiatric illness renal transplant is better than HD patients in total scores of General Health Questionnaires. In HD group we found that females' gender, low serum hemoglobin, and low urea reduction ratio are associated with psychiatric illness. Meanwhile, long duration after kidney transplantation and reduced glomerular filtration rate are associated with prevalence of psychiatric illnesses in transplant group. The prevalence of psychiatric illness leads to worsening the QOL among both groups. Meanwhile QOL is not related to any sociodemographic, clinical, and laboratory variables. ***Conclusions:*** Hemodialysis patients have worse QOL and more susceptible for psychiatric illnesses than posttransplant recipients.

Changing the Way We Work

Colleen Wile, Doris Kane, Leslie Jackson. QE II Health Science Centre, Halifax, Nova Scotia, Canada

Working in a busy clinic that provides acute and chronic hemodialysis treatments can be challenging for staff. Ensuring an adequate supply of health human resources now and in the future is also challenging. Imperative to safe patient care is ensuring the right person is providing the right care at the right time and that no resources are being wasted. Our hemodialysis unit embarked on a new initiative "Changing the Way We Work," to create a practice environment in which RNs, LPNs, and NPs could optimize their respective scopes of practice within the hemodialysis unit to meet the needs of the patient population that we serve. An important component of the "Changing the Way We Work" initiative was to effectively integrate the support personnel into the care team. A working group consisting of LPNs, RNs, NP, renal assistants, nurse educators, a professional practice leader and the manager embarked on this journey to engage nurses and renal assistants as active participants in creating change and decision making at the point of care. This poster presentation will highlight the many tools and work that was completed within our hemodialysis unit by the staff to create a patient/family-centered work environment that supports nurses to work to their full scope of practice and provides an environment that supports effective utilization of the support staff.

Improving Mortality and Morbidity Rates Among New Dialysis Patients During the First 90 Days of Dialysis

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Background/Objectives: Several studies have highlighted multiple comorbidities and risk factors that are present in the majority of patients starting dialysis therapies the first 90 days of treatment. After assessing the current education practice for new dialysis patients, the Right Start Program was implemented to improve new patient quality outcomes. The patient's improvement in qual-

ity indicators such as albumin, hemoglobin, phosphorus, and urea clearance decreased the mortality and hospitalization rate in comparison to patients receiving no Right Start education. New patients with a <2 weeks start date were identified. One-on-one education began on a test group of 10 patients. Objectives: (1) Patient will be able to verbalize understanding of dialysis regimen and schedule. (2) Patient will also demonstrate a clear understanding of dietary restrictions and lab values and recommended goals. (3) Patients will also verbalize understanding of medications and their action. ***Methods:*** Ten new patients received early intervention education using the Right Start education modules and a control group of 7 patients new to dialysis received new patient education currently being practiced in the dialysis microsystems. Patients were assessed for learning style and ability to comprehend reading material. The patients were given handouts regarding each variable discussed. Evaluation consisted of discussions followed by lab results review. Patients were given a short multiple-choice test to assess retention of knowledge. ***Results:*** The 10 patients that received early education had no deaths in comparison to 2 deaths recorded in the patients who did not participate in the Right Start education plan. There were no hospitalizations for participants in Right Start and >21 days reported for the control group. The decrease in hospitalizations and deaths results in more billable dialysis treatments. Ninety percent of the educated participants met their goal with no hospitalizations, generating a cost saving of $31,195. ***Conclusion:*** According to evidence-based practice, early educational intervention positively influences quality indicators for new dialysis patients who are at risk for higher mortality and hospitalizations. There was a significant improvement in laboratory quality indicators and reduction in mortality and hospitalizations for patients who received educational intervention.

Chronic Kidney Disease and Vein Preservation: A Provincial Approach

Richard Luscombe, Jocelyn Hill, Cathy Duerkson, Janet Willaims. Vancouver Coastal Health Authority, Vancouver, British Colombia, Canada

Preservation of veins in patients with chronic kidney disease who may or may not be on hemodialysis is crucial for the successful future creation of arteriovenous fistulas and grafts. Frequent venipunctures and the indiscriminate use of peripheral intravenous lines can damage veins, impair the circulatory system, and jeopardize future fistula and graft creation and/or function. This presentation will demonstrate a multi-disciplinary, multicenter and cross-continuum approach to the development and implementation of a provincial guideline on vein preservation in people with chronic kidney disease. The guideline makes 4 recommendations, including an algorithm to assist health care providers in selecting the most appropriate vein for venous access sites. Educational material was also developed to support the implementation of the guideline and targets both health care professional and patients.

Encouraging and Supporting Patients to Make Their Own Healthcare Decisions

Janet Baker, Vanessa Deck, Maria Doyle. Halton Healthcare Services, Oakville, Ontario, Canada

There is a growing trend to encourage and support patients who want to be active in the decisions surrounding their healthcare. This is most often referred to as Self-Management and the renal setting is the perfect environment to support patients in decision making. Self-Management is a fundamental component of many models of care for chronic disease prevention and management in today's healthcare. The evidence points toward patients and their caregivers wanting to participate in their care decisions. In the chronic kidney disease setting these decisions can take place in many formats including predialysis clinics and in-center hemodialysis units. It can range from patients on home therapies and cover all facets of multidisciplinary care. The decisions that our patients make can be as simple as deciding to monitor their own blood pressure or glucose at home or as large as starting or withdrawing from dialysis care. What is the role of the renal team in this climate of patient decision making? It can be confusing for patients as well as staff. How can members of the renal team educate patients in the decision-making process and how do we support patients in making these crucial decisions? The predialysis unit at our hospital adopted the philosophy of self-management and supporting our patients as they make educated decisions regarding their care. How did the renal team change their patient approach? How did this change in care philosophy modify the role of the team who work with this group of patients? Are our patients happier and are our measured outcomes different? Our multidisciplinary team had training in self-management strategies and then decided on the areas that would be most appropriate for the introduction of self-management to our patients. Each discipline in the clinic developed group classes for patients to attend as they desired. We are finalizing a patient binder "Helping you to be an active participant in the management of your kidney disease" and hope to roll this out in January 2011. This change in care philosophy has been a year long process and not without challenges, however, we all believe that this is the best for our patients and our patients are responding well to this change. They are voluntarily signing up for classes and we have seen a positive shift in the decision making done by our patients. They seem more confident in their decisions as it pertains to the management of their renal disease and more satisfied in general.

It Can Work: Daily Hemodialysis in a Rehabilitation Facility

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The increasing prevalence of end-stage renal disease in patients older than 75 years presents unique challenges in providing appropriate dialytic care. The associated comorbid issues in this

population frequently require admission to nursing homes (NH) or rehabilitation facilities (rehab). The most effective way to provide concomitant adequate hemodialysis (HD) and rehabilitation services is unknown. The current NH/rehab model provides conventional HD 3 times a week. Often, rehab services are foregone on these days secondary to patient fatigue and scheduling conflicts. A novel paradigm utilizing daily home HD with the NxStage system was executed at 1 NH in August of 2009. Dialysis was administered 5 days a week with no interruption of prescribed rehab services. An additional goal of the program was to expose patients to home dialysis therapies with eventual discharge to either NxStage or peritoneal dialysis (PD). Training of home therapies was coordinated while at the NH. Dialysis naïve nurses from the rehab facility were trained for 1 month in NxStage. With growth of the program 2 technicians with HD experience were also trained. In 1 year the program provided dialysis to 30 patients aged 60 to 80 years. Nearly half of the 30 patients were newly diagnosed with chronic kidney disease and recently initiated renal replacement therapy. Treatment length was typically 2. 5 to 3 hours 5 days a week. The average Kt/V was >2.1, and all subjects received weekly SQ erythropoietin. Intravenous iron was administered as needed at the local hospital infusion center. The average stay was for 1 to 2 months. Two deaths were reported that were not related to dialysis therapy. Two (6%) of the patients were successfully trained and discharged on home therapies. A daily HD program with NxStage is a feasible and effective way to provide dialysis in a NH/rehab setting. In this center, patients were able to fully participate, progress in rehabilitation and eventually be transferred out of the rehab facility with improved independence. Notably the program was successful in transitioning patients to home dialysis. Further randomized studies are warranted to assess optimal regimen for HD in rehab setting.

Improving Home Dialysis Patient Retention: Quality Assessment and Performance Improvement

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Patient retention is important in home dialysis training programs. Training patients who do not succeed or who transfer to other facilities for their follow-up care is costly and demoralizing for staff and disrupts patient care. Literature reports of dropout rates from home dialysis are difficult to compare and there has been no average US rate reported in recent years. An analysis of our own data from January 1, 2009 to September 15, 2010 showed that 28% of patients who began home dialysis training at our center transferred to other facilities, mostly for in-center hemodialysis, which we do not offer. Most could be explained as "treatment failures" due to difficulty learning or adhering to treatment requirements. Some had family dynamics that proved unsuitable for home therapy, and some found other facilities closer to home/work for their follow-up care. We are concerned that our drop-out rate is unacceptably high. We have started a QAPI project to analyze the situation and implement changes. An analysis of our transfers-out pointed to nonadherence (as evidenced by repeated missed and/or shortened training sessions, failure to complete required documentation, and missed laboratory draws), and difficulty adjusting to stage 5 chronic kidney disease as potential root causes. Our QAPI process, therefore, will focus on how we can better assist candidates to adjust and adhere to the limits and rigors of home dialysis. We decided on an interdisciplinary approach, meeting with the social worker, the dietitian, and the nurses in the training center to discuss the best methods for dealing with patients who do not adhere to treatment requirements, and to brainstorm approaches that might help those patients as well as those with complex family issues to be successful on home dialysis. Our presentation will detail the solutions we are testing and present preliminary observations about our success.

All-Hazards Emergency Preparedness and Planning in 2009 to Prevent Dialysis Treatment Interruption

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Locally and federally declared disasters and emergencies ranged from severe weather events across to man-made chemical spills that disrupted dialysis services temporarily, throughout the year. Using an all-hazards disaster planning approach, the effects on dialysis patients can be mitigated or prevented. A review of the federally declared disasters and emergencies in 2009 was done and categorized with recommendations for dialysis patients to prevent morbidity and mortality from the emergency or disaster. Disasters in 2009 extended across the nation, but were primarily related to severe storms throughout the year. Secondary effects from severe storms led to interruption of utilities, which resulted in disruption of dialysis services temporarily in most areas, occurred in some areas for extended periods. Alternate dialysis services were arranged when services were interrupted. By developing and reviewing disaster plans periodically, dialysis providers and patients can recover early and minimize interruption of dialysis services. Recommendations are made to mitigate the effects of the disaster on patients and assist dialysis providers in rapid recovery from disaster. Using the all-hazards disaster planning approach, dialysis patients and providers are constantly prepared for interruption in dialysis services by natural or man-made emergencies and disasters. Dialysis providers are required to develop and implement disaster plans for patients and their services as a part of the current Medicare conditions for coverage. Information from this review of emergencies and disasters may be used to optimize emergency preparedness resource utilization to provide efficient use of dialysis services during declared emergencies and disasters.

Home HD

Adoption Barriers to Nocturnal Home Hemodialysis in Hong Kong (HK): A Three-year Review from Queen Elizabeth Hospital, HK

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Background: Nocturnal home hemodialysis (NHHD) was started as a pioneer program in Queen Elizabeth Hospital (QEH) in May 2007 to serve the increasing HD demand in Hong Kong (HK). Major barriers to NHHD in HK included (1) patients had to pay for part of the program, (2) HK is adopting PD first policy, (3) limited household space in HK. A cross-sectional survey was created to assess the attitude of staff toward NHHD and to identify the reasons for the low utilization rate of NHHD in HK. We hypothesized that this survey can help the future development of NHHD in HK. ***Methods:*** Nocturnal home hemodialysis is established as an alternate night HD (3.5 times/wk, 8 hours per treatment) therapy. In QEH, we have 268 CAPD patients and 70 chronic center HD patients. Since May 2007, 19 patients (10 M:9 F) with mean age of 44.9 ± 10 years old were recruited. Eighteen patients attained full vocational rehabilitation after conversion to NHHD. The mean household size of patients was 690 ± 242 sq ft. All renal staff in QEH including 36 renal nurses and 8 renal physicians had completed the survey. The survey will be distributed and extended to all renal staff in HK. ***Results:***

Perceived percentage of patients experiencing PD failure	10% to 20%
Perceived percentage of existing center HD patients can be converted to NHHD	At most 10%
Percentage of staff perceiving NHHD is posing stress to family members	74%
Percentage of staff perceiving NHHD as most ideal form of RRT	65%
Perceived major barriers to NHHD	Financial barrier and self-cannulation
Perceived optimal frequency for NHHD	Alternate night NHHD and 5 times/wk NHHD

Conclusion: This survey identified the barriers and attitudes toward NHHD in HK as perceived by renal staff and formed the basis for the future planning and development of NHHD in HK.

How is a Patient Trained for Home Hemodialysis in 4 to 6 Weeks?

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Helsinki University Central Hospital in Finland has from the beginning of 1998 trained 232 patients to perform home hemodialysis. The training program has been fine tuned, so that only the essential information regarding patient care remains. This has also impacted the training time required for patient education that has now been condensed to a very short time period. The in-centre unit training period is 4 to 6 weeks, after which the patient transfers to home to perform self-sufficient hemodialysis. During the training period the patients go to the in-center unit 4 to 5 times/wk. The traditional hemodialysis machine gives patients the freedom to plan their treatment within their own day-to-day schedules. Patients perform their dialysis treatment in various individual ways, either during the day or night. Sometimes patients can also mix both night and day treatments together. Treatment time and day can be changed in a swift and individual basis. A short training time necessitates effective planning and swift action, what enables patients to quickly transfer to the hemodialysis setting. Patient training commences straight away from the first treatment date in the in-center unit. Inserting dialysis needles is begun when the trainer knows where the patient's good veins are located. The patient commits to the training period by agreeing to a withdrawal date to the home setting during the first training session. As well as learning the basics of their hemodialysis treatment, it is very important for the patients to learn to take responsibility for their own treatment. At first the trainer strongly supports the patient and creates a sense of security for the patient that this treatment will work. At the same time a relationship of trust is created between the patient and the trainer, that enables the patient to try to manage by themselves at home. The trainer must also allow the patient to fail, as this is an important part of the training. Home visits, technical modifications to be made in the home and various other issues to be considered are begun straight away from the start of the training session, so that patients withdrawal date to the home hemodialysis setting does not get delayed. On-call support is an indispensable service after the intensive training period. It helps to decrease patient anxiety when transferring to the home hemodialysis setting as well as creating a safety net for the patient.

Calcium and Phosphorous Flux During Long Hemodialysis Sessions

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Background: Long, overnight hemodialysis (HD) may have benefits over conventional HD due to increased removal of phosphate (Pi) and other uremic toxins. Typically, calcium (Ca) baths of 3.0 to 3.5 mEq/L are used to prevent negative Ca balance and bone loss, Pi removal of >800 mg per session is needed to eliminate Pi binders, and target urea reduction ratios are $\sim 50\%$. The System One (NxStage Medical, Lawrence, MA, USA) system is primarily utilized for short-daily HD with small dialysate volumes. The purpose of this pilot trial is to study removal of uremic toxins using the NxStage system for extended-time HD. ***Methods:*** End-stage renal disease patients currently using the NxStage system underwent 4 HD sessions with varying times and dialysate volumes (see Table 1), using a dialysate Ca of 3.0 mEq/L. Timed samples of blood and spent dialysate were collected throughout the treatments. Spent dialysate was pooled and mixed samples

were used to calculate total removal of each substance. ***Results:*** Five patients completed all 4 treatments. Removal of various substances per treatment is shown in Table 1. Mean removal of protein and albumin were 4.0 and 0.8 g respectively. ***Discussion:*** This is the first study to quantify Ca, Pi, and B2M removal during extend-time dialysis using the NxStage system. Pi removal may be sufficient to eliminate the need for oral binders. A Ca bath of 3.0 mEq/L resulted in essentially net-zero intradialysis Ca balance with ultrafiltration. A substantial fraction of B2M removal in HD occurs by adsorption, so true removal was likely higher than estimated by dialyzer-side measurements. Urea removal met the target for other extended dialysis studies. ***Conclusion:*** The System One (NxStage) system used in long HD sessions results in substantial removal of uremic toxins, and deserves further study in larger trials of extended dialysis.

Table 1*

	Ca (mEq)	Pi (mg)	B2M (mg)	UN (mg)	UN/TBUN
All*	1.13 ± 5.9	1029 ± 382	265 ± 98	12380 ± 3331	0.74 ± 0.26
8 h, 40 L	1.16	1122	299	11521	0.59
8 h, 60 L	0.75	1239	290	13100	0.82
5 h, 40 L	2.04	859	211	11587	0.77
5 h, 60 L	0.47	887	256	13331	0.74

*Values are mean ± SD.
B2M = B2-microglobulin; Cr = creatinine; est. from pre-HD BUN and weight; TBUN = total body urea nitrogen; UN = urea nitrogen.

A Longitudinal Follow-Up of Quality of Life Among Patients on Nocturnal Hemodialysis

David Lau, Raelene Hungerford, Trish Kinrade, Robert MacGinley, Rosemary Simmonds, Christine Somerville, John Agar. Department of Renal Medicine, Barwon Health, Geelong, Victoria, Australia

Background: Studies have shown that nocturnal hemodialysis (NHD) improves quality of life (QOL) when compared with conventional dialysis regimens. However, to our knowledge, there is currently no published QOL data of NHD patients followed over a prolonged period. We report the QOL outcomes for NHD over an 8-year period. ***Method:*** Using the KDQOL-36, a validated tool in assessing QOL in dialysis subgroups, QOL data were collected annually from 2001 to 2009. Patients were categorized by their NHD vintage. ***Results:*** A total of 111 surveys were returned in the 8 years, with a total of 314 patient-years on NHD. The 2 QOL domains reflecting the "prevalence of symptoms" and the "individual restrictions placed on lifestyle by dialysis treatment" both scored similarly and were sustained at a consistently high level throughout the 8-year study. However, our NHD patients did still feel that the total burden of their kidney disease and its treatment requirements remained significant, as was reflected by their lower though also stable scores for the "burden of kidney disease." Further analysis revealed statistically significant improvements ($P < 0.05$) in pre-NHD and 6 months scores in the domains, Burden of Kidney Disease and Effect of Kidney Disease. ***Conclusion:*** This study reveals that the symptom impact and lifestyle limitations in the NHD group are broadly mild and do not deteriorate throughout an 8-year follow-up period. However, there was a pervasive perception of frustration at the interference kidney disease had on overall lifestyle. This impression persisted throughout the study period. This data suggests that despite the lack of major lifestyle limitations, and despite physical and mental stability, NHD patients are still dialysis-dependent—an unalterable, permanent, additional encumbrance in their daily lives.

A Comparison of Quality of Life Across the Three Dialysis Modalities

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Background: Numerous observational studies have shown the superiority of nocturnal hemodialysis (NHD) over conventional dialysis regiments, confirming improvements in left ventricular mass, reduction in antihypertensives and phosphate binders, as well as better quality of life (QOL). To date, QOL comparison studies have been few, numbers small, and duration short. Our 6-year longitudinal prospective study compares QOL in NHD, satellite (SHD), and peritoneal dialysis (PD) patients, using KDQOL-36™, a validated QOL tool in dialysis subgroups. ***Methods:*** The KDQOL-36™ questionnaire was collected at intervals of at least 6 to 12 months, from 2004 to 2009, results grouped into years since commencing dialysis. ***Results:*** A total of 34, 19, and 29 surveys were returned from patients who had been on dialysis for 0 to 1 year; 78, 15, and 33 (1–3 years); 83, 11, and 19 (3–6 years); 92, 2, and 5 (>6 years), in the SHD, PD, and NHD groups, respectively. Quality of life in NHD did consistently better than both SHD and PD, across all domains of the KDQOL. Nocturnal hemodialysis also maintained superior QOL over time. Satellite hemodialysis also maintained similar QOL scores over time. There was a slow but consistent trend toward improvement in the burden and effect of kidney disease domains in patients who had been on 6 or more years of SHD. Peritoneal dialysis did poorly in our study, with QOL scores falling markedly with time, across all domains, though numbers were small. We do acknowledge volunteer bias and an incomplete data set as potential confounders for this data. ***Conclusion:*** This comparative study, conducted over a significantly longer period of observation than previous studies has confirmed that NHD sustains QOL over a 6-year period, in addition to its QOL superiority over both SHD and PD.

Analysis of Blood Platelet Counts in Home Daily Hemodialysis

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Study Design: We retrospectively analyzed blood platelet counts from 54 home daily hemodialysis (DHD) patients from the Dialysis Center of Lincoln (DCL), NE, who initiated home DHD therapy on the NxStage System One between 2004 and 2009. Monthly blood platelet results were collected for each patient from the time they transferred from conventional in-center HD (CHD) up to and including their most recent count on DHD, as of July 2010. For patients that discontinued DHD before this time point, data were collected up to the time of discontinuation. Analysis consisted of a comparison between baseline (last count before transferring from CHD) and the last recorded count on DHD (last count). A subanalysis was performed on the number of patients with low platelet counts ($<$100,000, and $<$150,000). A separate analysis was performed to assess the month-to-month variation of platelet counts over a 6-month period between April and September 2009. ***Patient Characteristics:*** Mean $\pm$ SD age was 60 ± 14 years, 54% were female, 96% were white, mean $\pm$ SD BMI was 31 ± 8 kg/m^2, and 63% used an arteriovenous fistula. Diabetes was the primary cause of end-stage renal disease in 39%. The mean time on DHD was 2.7 ± 1.8 years. ***Results:*** Baseline vs. last counts are presented in the table below.

N=52[1]	Baseline	Last count	P value
Mean count of all patients (1000s)	210 ± 68	205 ± 79	0.64[2]
No. of patients with $<$150,000	8 (15%)	11 (21%)	0.31[3]
No. of patients with $<$100,000	3 (6%)	4 (8%)	0.56[3]

[1]Baseline data were not available for 2 patients.
[2]P value by signed-rank test.
[3]P value from MacNemar test.

Average counts for all patients between the months of April to September 2009 are presented below.

	April 2009	May 2009	June 2009	July 2009	August 2009
N	38	32	39	46	47
Count (1000s)	197 ± 74	202 ± 71	196 ± 78	201 ± 71	199 ± 74

Summary: Results show mean blood platelet counts did not change (210,000 vs. 205,000) over a mean follow-up time of 2.7 years on DHD. There was no significant change in the number of patients that recorded low platelet counts ($<$100,000 and $<$150,000). Results over the 6-month timeframe between April and September 2009 remained very consistent on a month-to-month basis. ***Conclusion:*** Daily hemodialysis does not appear to have any impact on blood platelet counts. Long-term follow-up of patients that transfer from CHD to DHD shows blood platelet counts are maintained at similar levels, with no change in the number of patients with low platelet counts. Overall platelet counts remain very consistent on a month-to-month basis.

Infection, Inflammation

Klebsiella Pneumoniae Liver Abscess in a Hemodialysis Patient

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Background: Pyogenic liver abscess is uncommon in patients with end-stage renal disease undergoing maintenance dialysis therapy, but it is still a disease of significant mortality. We report a 85-year-old man on hemodialysis with liver cirrhosis, who developed Klebsiella pneumoniae liver abscess and then pneumonia with neutropenia and fatal outcome. ***Case report:*** An 85-year-old man, who had history of liver cirrhosis and had been on hemodialysis treatment for 3 months, was admitted with fever, weakness, and general malaise. Physical examination on admission revealed right upper quadrant tenderness Lab data showed leukocytosis and elevated alkaline phosphatase. Abdominal ultrasound revealed a 7.2 cm hypoechoic mass with ill-defined margin at S5-6 junction, with cystic change and septums inside. Abdominal computed tomograpgy showed a ill-defined cystic lesion with septation and perifocal edema at S5-6 of liver noted, size about 5 cm. Pyogenic liver abscess was impressed and managed with intravenous antibiotics and continuous catheter drainage. Fluid culture was positive for Klebsiella pneumoniae. Severe leukopenia with WBC low as 370/μL developed and then antibiotics adjustment to piperacillin/tazobactam was done. However, spiking fever and shortness of breath developed 3 days later and CXR showed pneumonia. Antibiotics coverage including meropenem, levofloxacin, and vancomycin were used. However, disease progression was noted and hypotension developed. The patient finally expired on day 22. ***Conclusion:*** We report a fatal case of Klebsiella pneumoniae liver abscess and pneumonia with severe neutropenia in a patient with end-stage renal disease undergoing maintenance dialysis therapy.

Inflammation Markers, Chronic Kidney Disease and Renal Replacement Therapy

Bernardo A. Lavin[1], Rosa Palomar[2], María Gago[2], Estefanía Gomez[1], Jose Antonio Quintanar[1], Domingo González-Lamuño[3], Manuel Arias[2], Juan Antonio Gómez-Gerique[1]. [1]Clinical Biochemistry (Dyslipidemia and Vascular Risk Unit); [2]Nephrology Department; [3]Pediatric Department, H.U.Marqués de Valdecilla Santander, Cantabria, Spain

Introduction: Many studies show that the immune system participates actively in the development of vascular disease. Early stages of atherosclerosis are characterized by an infiltration of inflamma-

tory cells in the vascular wall, attracted by innate immunity. That is the reason why many researchers are interested in the study of these markers of inflammation (protein-standardized C-reactive protein [cCRP], pentraxin-3 (PTX3), the serum component of amyloid A (SAA), and procalcitonin (PCT). The aim of our study was to describe the changes in emerging markers of innate immune and inflammatory response in populations with different degrees of renal function. ***Material and Methods:*** We obtained serum-EDTA plasma of 139 individuals (69 people with normal renal function (GP) Group 1, 25 chronic renal disease (stages IV and V) Group 2, 22 peritoneal dialysis (PD) Group 3, and 23 hemodilaysis (HD) patients Group 4. We analyzed the following serum biomarkers: creatinine (sCre) (RXL2000 Dimension, Siemens Healthcare, Mannheim, Germany), cCRP, SAA, Cystatin-C (CysC) by immunonephelometry (BN-II, Siemens Healthcare), PCT by immunoassay (BRAHMS-PCT-sensitive, Kryptor, BRAHMS GmbH, Hennigsdorf, Germany), and plasma PTX3 by ELISA (Human Pentraxin3/TSG-14 ELISA System, Perseus Proteomics, R&D Systems, Minneapolis, MN, USA). The statistical treatment of data (U-Mann-Whitney significance if $P<0.050$) was carried out with the program Medcalc. ***Results:*** See Table 1. ***Conclusions:*** Protein-standardized C-reactive protein is increased in chronic kidney disease and does not increase with renal replacement therapy. pentraxin-3 increases only when end-stage chronic kidney disease on HD. Serum component of amyloid A, acute phase reactant, has a similar behavior to C-reactive protein. Of particular relevance is that PCT increased progressively as glomerular filtration rate declined, this increase was higher in PD and HD patients, which can confuse the evaluation of septic states in these groups.

Table 1 Results

	(1) GP (n=69)	(2) CKD (n=25)
sCre (mg/dL)*	0.91 (0.88–0.95)	3.95 (3.48–4.41)
CysC (mg/L)*	0.81 (0.75–0.86)	3.16 (2.89–3.44)
cCRP (mg/L)**	1.40 (1.19–2.11)	6.50 (3.57–8.32) a
SAA (mg/L)**	0.55 (0.30–0.95)	7.11 (5.07–29.47) a
PCT (ng/mL)**	0.02 (0.02–0.03)	0.12 (0.09–0.16) acd
PTX3 (ng/mL)**	0.54 (0.30–0.95)	0.71 (0.32–1.50) d
	(3) PD (n=22)	(4) HD (n=23)
sCre (mg/dL)*	7.46 (6.40–8.52)	8.15 (7.33–8.96)
CysC (mg/L)*	5.34 (4.64–6.03)	5.56 (5.05–6.05)
cCRP (mg/L)**	7.60 (2.19–22.10) a	9.60 (6.62–16.38) a
SAA (mg/L)**	9.69 (5.07–29.47) a	15.90 (6.80–37.48) a
PCT (ng/mL)**	0.32 (0.20–0.46) abd	0.79 (0.45–0.99) abc
PTX3 (ng/mL)**	1.52 (0.65–2.13) a	1.67 (1.05–2.27) ab

*Mean.
**Median.
a: $P<0.05$ when compared with (1); b: $P<0.05$ when compared with (2); c: $P<0.05$ when compared with (3); d: $P<0.05$ when compared with (4).
GP=general population.

Pyuria In Hemodialysis Patients: Is It Significant?

Dawlat Sany, Yasser El Shahawy, Ahmed Aziz, Osama El Nabarawe. Department of Nephrology, Ain Shams University, Cairo, Egypt

Background: Dialysis patients are more susceptible to urinary tract infections (UTI). Delayed diagnosis is a relevant issue because the urinary tract is often overlooked as a source of infection in dialysis patients. The diagnostic accuracy of pyuria in hemodialysis patients has been incompletely evaluated and so the object of this study to evaluate the value of pyuria in the diagnosis of asymptomatic urinary tract infection among hemodialysis patients. ***Setting and Participants:*** Fifty patients on regular hemodialysis with urine output >200 mL/d were dialyzed 3 times weekly with polysulfone dialyzer membrane, and bicarbonate dialysate. Microscopic examination of urine for pyuria was done for all subjects as well as and urine culture and sensitivity. ***Results:*** Thirty-two percent had pyuria ≥ 10 pus cells/HPF together with significant bacteriuria. Among this group 87.5% had positive urine culture. Pyuria ≥ 10 cells/HPF was shown to have high sensitivity, specificity and negative predictive value (0.875, 0.94, 0.96), respectively, for diagnosis of urinary tract infection. In studied subjects with positive urine culture *E. coli* was the most prevalent organism. ***Conclusions:*** There is high prevalence of pyuria and asymptomatic bacteriuria in the hemodialysis patients. Pyuria ≥ 10 cells/HPF is always associated with significant bacteriuria and positive urine culture, so pyuria may be used in detection and follow-up of asymptomatic bacteriuria.

Humoral Immune System Dysfunction in Chronic Kidney Disease: Role of Parathyroid Hormone

Dawlat Sany[1], Yasser El Shahawy[1], Hany Refeat, Manal Mahran[2], Mona Hosny[1]. [1]Department of Nephrology, Nephrology and Hypertension Division; [2]Clinical Pathology Department, Ain Shams University, Cairo, Egypt

Background: Chronic kidney disease (CKD) is a globally increasing condition associated with secondary hyperparathyroidism and immunological disorders. ***Methods:*** Sixty patients with CKD (predialysis), and 20 healthy volunteers. Group I: 38 cases with high PTH levels. Group II: 11 cases with normal PTH levels. Group III: 11 cases with low PTH levels. Group IV: Twenty healthy volunteers as control, blood study including S. Parathyroid hormone level by ELISA test, B-cell by flow cytometry, measurement of IgM and IgG concentration by radial immunodiffusion (RID). ***Study Design:*** Cross-sectional study to evaluate immunological state of CKD. ***Results:*** This study showed significant difference between cases and control group regarding WBC count, lymphocyte %, B cells %, IgM, IgG levels, and all the immunological parameters were lower in cases signifying marked humoral immune suppression in CKD, but there was no significant difference between CKD patients with high (38 cases) and normal PTH (11 cases) level regarding the immunological parameters. Also there was no significant correlation between PTH level and all the immunological parameters although the mean value of all the immunological parameters were lowest in CKD patients with high PTH level indicating

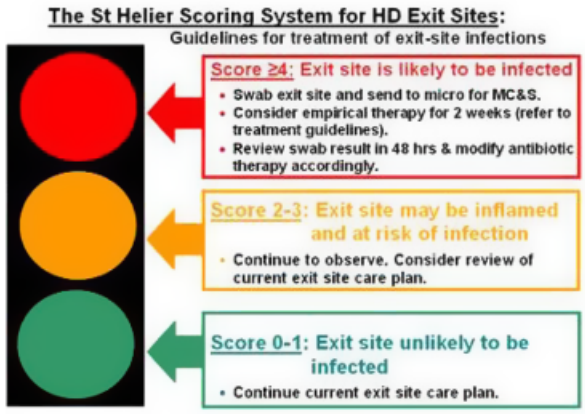
that PTH may not the only factor responsible for immune deficiency. ***Conclusions:*** Chronic kidney disease patients have immune defect.

Development and Validation of a Hemodialysis Catheter Exit Site Evaluation Tool

David Makanjuola, Siddiq Anwar, Joseph Arthur, Maggi Steele, Pauline Swift. St Helier Hospital, Surrey, UK

Introduction: Catheter related infection is an important cause of morbidity and mortality in dialysis patients. A systematic approach to the evaluation and care of the catheter exit site for peritoneal dialysis has been established by Twardowski and Prowant. Currently there is no similar tool available to evaluate exit sites of hemodialysis catheters. ***Methods:*** We have developed an exit site scoring system, which aims to provide a systematic method of exit site evaluation and thus will hopefully help improve the identification of possible exit site infections (ESIs). The intention is that any member of the dialysis team should be able to look at the exit site at any hemodialysis session and make an assessment of the exit site using straightforward objective clinical signs. The presence of 1 or more of these signs is awarded a score. The total score then guides the management of a potential ESI. We have undertaken a validation exercise by getting various members of the medical and nursing team to assess a panel of different exit-site photographs to see what the interobserver variation in scoring was. The sample size was small (n = 15), but the concordance with regard to discriminating between scores > or < 4 was > 80%. We are in the process of carrying out a validation exercise on a larger group. ***Discussion:*** Since we introduced the scoring system as part of a catheter care bundle in 2007, we have noticed a reduction in ESIs by about 60%.

Conclusion: While we cannot completely attribute the reduction in ESIs to the scoring system alone, we have found that it has led to a significant reduction the number of inappropriate exit site swabs, thus preventing inappropriate administration of antibiotics. We believe that this scoring system will help to standardize the practice of identifying ESIs and improve care of the exit site in the long term.

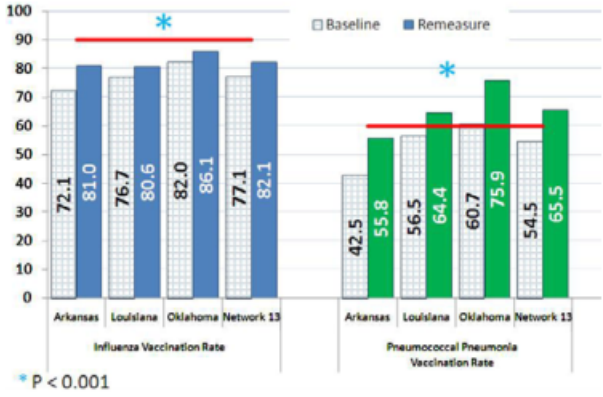


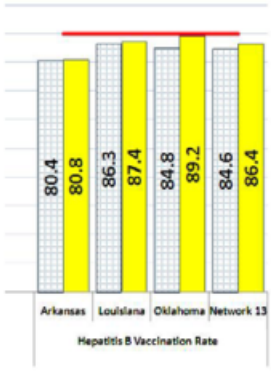
PARAMETER	SCORE
REDNESS	1
SWELLING	1
PAIN/TENDERNESS	1
EXUDATE / CRUST	2
PUS	4

Partnership within Network 13 to Improve the Dialysis Patient Immunization Rates for Influenza, Pneumococcal Pneumonia, and Hepatitis B

Linda Duval, Cheryl George, Niloufar Hedrick, Sandra Woodruff, Myra Kleinpeter. ESRD Network 13, Oklahoma City, Oklahoma, USA

Objectives: Immunizations are available for primary prevention of many infections for adults. Adult hemodialysis and peritoneal dialysis patients despite having many opportunities for immunization are often missed. A performance improvement project was conducted to increase the rates of influenza during the recent H1N1 influenza outbreak. The project included an education phase, baseline assessment of immunization rates, intervention and follow-up assessment of immunization rates. ***Methods:*** At the beginning of the Network-wide project, overall across each state, influenza immunization rates were below the Centers for Disease Control and Prevention (CDC) reported average influenza immunization rate for adults and far below the Centers for Disease Control and Prevention target for adults. This project incorporated methods for educational interventions to improve patient acceptance of immunizations, methods for educational interventions to improve staff participation in quality improvement activities, and improved techniques of quality improvement data collection and analysis by participants. Through this project, the immunization rates for hepatitis B and pneumococcal vaccine were also reviewed. The morbidity and mortality from invasive disease from *Streptococcus pneumonae* (pneumococcus) remains high and may be largely preventable through pneumococcal immunization of high-risk adults, including dialysis patients. The current 23-valent vaccine is widely available and is efficacious with a low adverse event profile. Revaccination is recommended in patients with immunocompromising conditions, including chronic kidney disease. ***Results:*** Improvement was demonstrated in all 3 focus areas at project's conclusion, with statistically significant improvements noted in both influenza and pneumococcal vaccinations rates as seen here.





Conclusion: The use of educational interventions to improve staff participation in QI, and collection and analysis of QI data can be replicated in many practice settings to improve immunization rates for dialysis patients and other patients with chronic illnesses.

Kinetics

A Simple Method to Estimate Phosphorus Mobilization in Hemodialysis Using Only Predialytic and Postdialytic Plasma Samples

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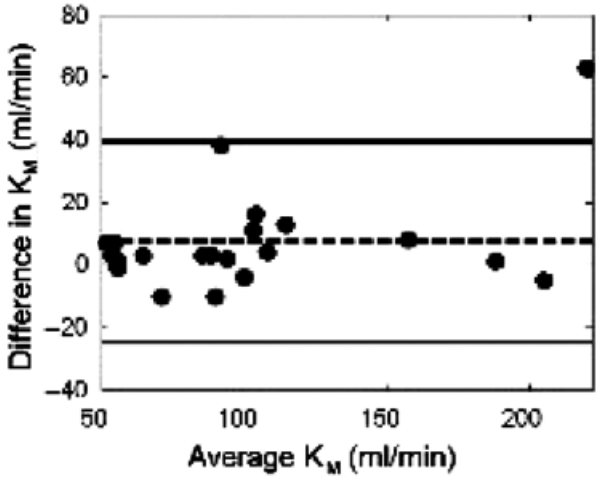
Background: We have recently developed a pseudo-single compartment kinetic model that includes phosphorus mobilization into plasma. This model was shown to describe intradialytic and postdialytic phosphorus kinetics. In this study, we made further simplifications to permit estimation of phosphorus mobilization clearance (K_M) from predialytic and postdialytic blood samples. ***Methods:*** The clinical data for the kinetic analysis were collected from 22 chronic hemodialysis (HD) patients during a conventional HD (CHD) session (241 ± 27 min, dialyzer phosphorus clearance (K_D): 146 ± 30 mL/min). The previously reported pseudo-single compartment model was used where the phosphorus mobilization rate was formulated as the difference between predialysis and instantaneous plasma phosphorus levels multiplied by a proportionality constant K_M. The model equations were simplified to estimate K_M from predialytic and postdialytic plasma phosphorus concentrations (C_{pre} and C_{post}), ultrafiltration rate (Q_{UF}), and measured K_D: $K_M = C_{post}(K_D - Q_{UF})/(C_{pre} - C_{post})$. The results from this simplified approach were then compared with those estimated from the full model using nonlinear regression. ***Results:*** K_M values estimated using simplified equation were 106 ± 54 mL/min compared with 99 ± 47 mL/min obtained from the full model. The Bland-Altman plot illustrates the 95% confidence interval (−25, 39 mL/min) and mean (7 mL/min) of the difference between estimated K_M using each method. ***Conclusions:*** A simple method using only predialytic and postdialytic plasma phosphorus concentrations resulted in estimates of phosphorus mobilization clearance similar to those when using the full model; this approach may allow easy clinical evaluation of phosphorus kinetics during HD.



Modeling Phosphorus Kinetics During Short and Conventional Hemodialysis Treatment Sessions

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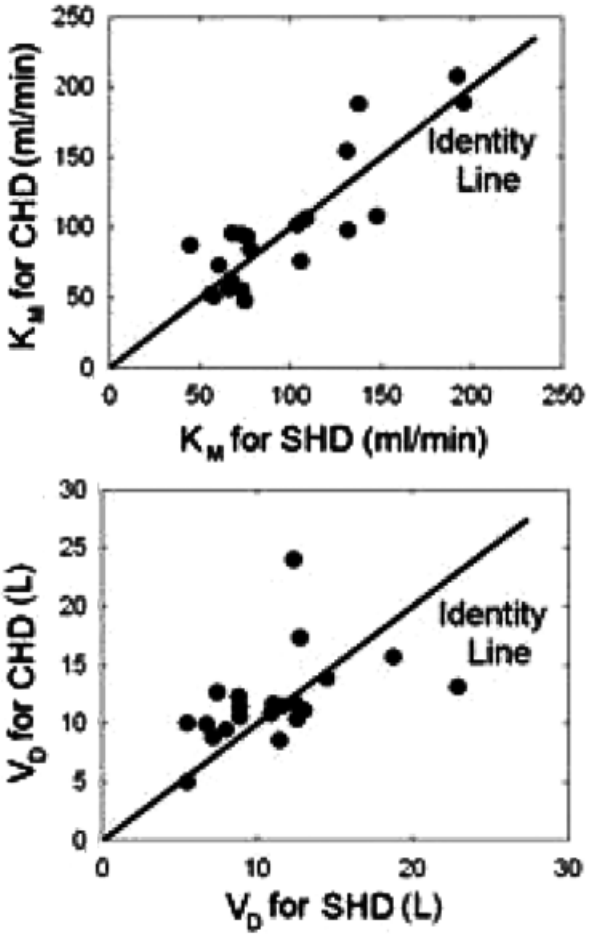
Background: The kinetics of plasma phosphorus during hemodialysis (HD) treatments cannot be described using conventional 2-compartment models. A pseudo-single compartment model including phosphorus mobilization from a large second compartment was used in this study to estimate patient-specific parameters during short and conventional HD treatments. ***Meth-***

ods: The phosphorus mobilization rate was formulated as the difference between predialysis and instantaneous plasma phosphorus levels multiplied by a mobilization clearance (K_M). Clinical data to evaluate the model were collected from 22 chronic HD patients (16 male, 6 female, 80 ± 20 (SD) kg, 61 ± 18 years of age). Each patient was treated by a short HD (SHD) session (116 ± 14 min, dialyzer phosphorus clearance (K_D): 152 ± 25 mL/min) and a conventional HD (CHD) session (241 ± 27 minutes, K_D: 146 ± 30 mL/min). Mobilization clearance and the distribution volume of phosphorus (V_D) were simultaneously estimated from several intradialytic and postdialytic (rebound) plasma phosphorus concentrations using nonlinear parameter estimation. ***Results:*** See figures below: estimates of K_M (98 ± 44 mL/min for SHD and 99 ± 47 mL/min for CHD) for each patient were correlated (concordance correlation coefficient [ρ_c] = 0.85) and were not different (P = 0.74). The distribution volume of phosphorus estimates of 11.0 ± 4.2 L for SHD and 11.9 ± 3.8 L for CHD ($\tilde{n}_c$ = 0.45) were also not different (P = 0.34). ***Conclusion:*** The proposed pseudo-single compartment model of phosphorus kinetics is relatively simple and describes phosphorus mobilization into plasma during HD treatments and postdialytic rebound.



Metabolism, Nutrition

The Effect of High-Protein Supplements on Serum Albumin Levels of Hemodialysis Patients

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Background: Analysis of monthly labs in our hemodialysis (HD) clinic showed only 20% to 30% of (HD) patients with an albumin of 4.0 g% or above. ***Objective:*** Since albumin is closely linked to overall health outcomes, and low albumin is a major predictor of mortality in HD patients—a plan was developed to improve albumin levels to 4.0 g% and above in at least 40% of our HD patients. ***Methodology:*** The study lasted 5 months, April through August 2010. Fifty patients participated. We offered VitalProtein RX protein bars, Nepro supplemental dietary drink, and hard-boiled eggs to HD patients—each dialysis day on each shift. The snacks contained an average of 16 g of protein. The snacks were distributed per individual patient preference. Documentation of acceptance or refusal was maintained only on patients whose albumin was below 4.0 each month. The dietician and nursing staff encouraged protein intake and educated the patients on the benefits of improved albumin ***Results:*** Sixty percent of patients in the study with an albumin below 4.0 g% accepted snacks at least 75% of the time. The other 40% of patients either accepted them occasionally or consistently refused. The average number of grams of protein per serving was 16 g. Those accepting snacks at least 75% of the time increased their protein intake by 36 to 48 g/wk. (The graph indicates the percentage of change in monthly albumin levels, and the percentage of times protein snacks were offered.) By the end of the study our goal of albumin of 4.0 g% or above for 40% or more patients was met. ***Summary:*** Even with good protein intake, other factors such as infection, edema, surgery, or certain disease conditions, can affect albumin levels. However, as a group, when protein intake increased, so did albumin. ***Conclusion:*** Increased protein intake with the provision of high-protein snacks at each dialysis treatment can help improve albumin values in HD patients. This correlates with better clinical outcomes for HD patients.

Carotid Atherosclerosis and Body Composition Assessment by Bioelectrical Vectorial Impedance in Chronic Kidney Disease Patients Stage 2-5ND

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Evidence suggests atherosclerotic vascular disease is a major cause of morbid-mortality in chronic kidney disease (CKD) patients.

The prevalence of carotid atherosclerosis (CA) by ultrasonoghraphy was significant higher in CKD than general population. The aim of cross-sectional study is to assess the relationship of CA with body composition markers. Two hundred twenty-seven patients with CKD stages 2 to 5, were examined by high-resolution B-mode ultrasonography (USBM) with a 7.5 MHz linear array probe (LogiQ PRO7, GE Healthcare Medical System, Milwaukee, WI, USA). Body composition assessment was performed by whole tetrapolar bioelectrical vectorial impedance analysis (BIVA) (EFG, Akern, Firenza, Italy). Data derived from BIVA were Na-K exchange, Phase angle, body cell mass/ECW ratio, PA standardized (PA and PA $\pm$ SD derived from healthy population). Data were analyzed by SPSS15.0. 168 (74.4%) had CA and compared with non-CA were older (68.66 $\pm$ 10.1 vs. 54.34 $\pm$ 10.5 years, $P<0.001$), Diabetic (36.1% vs. 17.3%, $P<0.001$) (Table 1).Carotid atherosclerosis is associated to older, lower glomerular filtration rate, diabetic and cellular damage expressed by increased Na-K exchange, lower PA, PA standard, and BCM/ECW ratio. Further clinical trials are required to explain this biologic difference.

Table 1 T-paired test

Variable	Non-CA (N=58)	CA (N=169)	P
Na-K exchange	0.96 $\pm$ 0.14	1.05 $\pm$ 0.19	0.001
Body cell mass (%)	50.91 $\pm$ 5.48	49.64 $\pm$ 6.22	0.001
ECW (%)	46.96 $\pm$ 4.62	48.96 $\pm$ 4.68	0.001
ICW (%)	53.03 $\pm$ 4.62	51.04 $\pm$ 4.69	0.001
Resting energy Expenditure (cal/d)	1510.1 $\pm$ 254.8	1430 $\pm$ 272.3	0.046
BCM/ECW (kg/L)	1.46 $\pm$ .30	1.32 $\pm$ 0.31	0.001
Phase angle ()	5.81 $\pm$ 0.9	5.42 $\pm$ 0.92	0.001
PA standardized	$-$0.62 $\pm$ 0.82	$-$0.98 $\pm$ 0.83	0.001
Hb (g/L)	13.70 $\pm$ 1.49	13.14 $\pm$ 1.54	0.001
Albumin (g/dL)	4.45 $\pm$ 0.29	4.30 $\pm$ 0.31	0.001

Study of the Relation Between Serum 25 and 1,25 Cholecalciferol and Glucoparameters in Type 2 Diabetic Prevalent Hemodialysis Patients

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Vitamin D is frequently given to hemodialysis (HD) patients for management of mineral bone disease (MBD). However, extra skeletal effects of vitamin D, and particularly on glucose homeostasis and insulin resistance in hemodialysis patients, are not well studied. The aim of this study is to assess the possible relation between serum 25 and 1,25 vitamin D levels and parameters of glucose homeostasis in chronic prevalent hemodialysis diabetic patients. Twenty patients suffering from type 2 diabetes mellitus on prevalent HD (group A), another group (B) of 20 nondiabetic prevalent HD patients, and a third group (C) of 12 normal subjects, were randomly selected. The 3 groups were similar in age, sex, and body mass index. All subjects were investigated by routine biochemistry in addition to assessment of serum 25 cholecalciferol and 1,25 cholecalciferol (by ELISA), serum Ca, PO_4, albumin, PTH (intact), as well as HbA1C, HOMA(IR), and HOMA-β cell%. We detected significantly lower levels of both 25 and 1,25 cholecalciferol in both diabetic and nondiabetic HD patients, compared with normal control. Both 25 and 1,25 cholecalciferol levels did not correlate with all studied glucoparameters except a significant positive correlation between serum level of 25 cholecalciferol and HOMA-B cell% in diabetic HD group (A). It may be concluded that vitamin D level is commonly deficient in prevalent HD patients, and it may be an aggravating factor for defective insulin secretion in type 2 diabetic patients on prevalent hemodialysis treatment.

Determinants of Malnutrition Inflammation Complex Syndrome Severity in Patients on Maintenance Hemodialysis Patients

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Objectives: Malnutrition Inflammation Complex Syndrome (MICS) is a common and universally identified condition among maintenance hemodialysis patients. Malnutrition inflammation score (MIS) is a comprehensive and quantitative system used to assess MICS. The aim of this study was to assess the determinants of severity of MICS in maintenance hemodialysis patient. ***Methods:*** We carried out descriptive cross-sectional study of patients undergoing hospital maintenance hemodialysis. Patients of age >18 years and on hemodialysis >1 month were included in the study. The MIS of each patient was recorded and variables such as age, sex, duration on dialysis, total iron-binding capacity (TIBC) level, cholesterol were analyzed. ***Results:*** A total of 63 patients were studied, the mean age was 68.4+14.7, sex (male: 65.08%, female: 34.92%), mean duration on dialysis in months was 51 (ranging 2–420), TIBC: 161+32.4. The mean MIS was 5.1+2.5. Duration on dialysis and TIBC were found to be strongly associated with severity of MICS, P values of 0.012 and 0.025, respectively. Age, sex, cholesterol level had no significant association with the severity of MICS. ***Conclusion:*** Our study revealed increased duration on dialysis and decrease in TIBC level as strong independent factors that determine the severity of MICS in patients on maintenance hemodialysis.

Heparin-Induced Extracorporal LDL Precipitation Apheresis in Hemodialysis Patients with Peripheral Arterial Disease

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Introduction: Peripheral arterial disease (PAD) is a major complication in patients with end-stage of renal failure (ERF). The mech-

anism by which HELP apheresis affects PAD is still disputable. We suggest that HELP apheresis affects positively oxygen stress in PAD patients with diabetes. ***Methods:*** We have performed HELP apheresis procedure in 3 patients. All 3 patients have been on dialysis treatment, however, for a different period of time. We have treated 2000 to 2500 mL of patient's plasma in every procedure, utilizing standard HELP system (HELP Futura). The procedures have been performed at every 6 months. ***Results:*** We have observed improvement of ischemic symptoms in 2 patients (66%). One procedure of HELP apheresis removes ~70% of LDL from patient's serum. Two of the patients have exhibited significant improvement of severe symptoms of PAD, such as skin ulcers, after serial HELP treatment. The fibrinogen levels have been decreased by 35% in every single procedure and these decreases continued over the entire period of therapy. ***Conclusions:*** HELP apheresis has improved ischemic symptoms in hemodialysis patients with PAD by reducing oxygen stress. We concluded that HELP apheresis is an effective treatment in hemodialysis patients complicated by PAD, as well.

Study of Vitamin D (25 and 1,25 Cholecalciferol) in Hepatitis C-Seropositive Prevalent Hemodialysis Patients

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Vitamin D deficiency is commonly recognized in prevalent hemodialysis (HD) patients who may have serious skeletal and extraskeletal complications in these patients. The liver is an important site for vitamin D synthesis (25 hydroxylation). The impact of hepatitis C virus seropositivity on serum levels of 25 and 1,25 vitamin D level in HD patients is not previously reported in the literature. The aim of study is to assess serum level of 25 and 1,25 cholicalciferol in prevalent hemodialysis patients. Twenty hepatitis C seropsitive (by ELISA) prevalent HD patients (Group A), another 20 hepatitis C seronegative (by both ELISA and PCR) prevalent HD patients (Group B), as well as a control group of 12 healthy subjects were randomly selected. All patients and control group were studied by routine biochemistry including serum Ca, PO_4, albumin, liver enzymes, bilirubin, PT, as well as CRP, PTH (Intact), serum levels both of 25 and 1,25 cholecalciferol (by ELISA). We detected significantly lower levels of both 25 aand 1,2 cholecalciferol in HD patients compared with control group. Moreover, though all our hepatitis C seopositive patients were CHID A chronic liver disease, yet their serum levels of both forms of vitamin D were significantly lower than seronegative HD patients, whereas there was no significant difference between the 2 groups of HD patients regarding Ca, PO_4, $CaxPO_4$ product nor PTH level. It may be concluded that hepatitis C seropositivity in prevalent HD patients may be associated with more severe deficiency of both 25 and 1,25 cholecalciferol serum levels compared with seronegative HD patients, which may need more attention to vitamin D supplementation in this group of patients.

Nursing

Population Care Management Program in an Integrated Healthcare System: How to Delay the Progression of Chronic Renal Failure through Patient Education and Empowerment Activities

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Kaiser Permanente is America's leading integrated health care organization. Founded in 1945, it is a nonprofit, group practice prepayment program with headquarters in Oakland, CA. Kaiser Permanente serves the needs of 9.2 million members in 19 states and the District of Columbia. Patients with chronic diseases are the most complex, expensive and highest utilizers of our healthcare system. By moving from management of symptoms to a proactive Population Management approach, we are able to identify patients at risk and manage their disease before they are acutely ill or at end of life. Our model can be applied to any population or disease management program. We would like to share the business case for population/care management and the progress we have made in Southern California Kaiser Permanente in our pre-end-stage renal disease (ESRD) and ESRD programs.*Core components of our model include*:

1. Early identification of patients at risk
2. Risk stratification
3. Clinical practice guidelines
4. Proactive management
5. Care coordination
6. Patient education
7. Outcome measurement
8. Continuous improvement.

Our program is customized to the individual member, assures a comprehensive approach and continuity of care and results in high-quality outcomes in a cost-effective manner. The multidisciplinary teams are led by the Renal Nursing Care Coordinator, who plays a critical role in the program's success. Her focus is on quality of care, customer service, and overseeing costs of care.

The Expanding Role of the LPN

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The LPN has been a member of the hemodialysis team in our unit for the past 18 years. With the increasing volume of dialysis patients, it became more evident that the knowledge/skill and competency of the LPN needed to be drawn upon in a more effective manner. Historically the role of the LPN was to act in the capacity of "ward aid." For example the LPN role included weighing patients, assisting with blankets/snacks, and washing machines. The role of the LPN has evolved over the last 8 years to maximize their

scope of practice to help meet the needs of the patient population they service. To meet the educational requirements to fulfill these new competencies, the LPN was provided with educational opportunities to learn how to prime the dialysis machines, needle-established fistulas, and perform transonic measurements and education on how to work in a collaborative care model with RNs in the delivery of care for identified stable patients. Additionally, an initiative in the hemodialysis unit began in 2007 with a mandate to ensure that the right person was providing the right care at the right time for the right patient population. In accordance with this objective, the LPN scope of practice was further enhanced to include education on medication administration and care of stable tunneled CVC catheters. All of these efforts have enabled LPN to maximize their practice thus enabling the RN to be able to coordinate and develop the plan of care for our dialysis patients.

Recognition Level About "Living Will" and "Right to Die" in Maintenance Dialysis Patient in Japan

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Background: In Japan, recently concern about discontinuance of maintenance dialysis or the nonintroduction of the dialysis in end-stage renal disease patients was increasing, especially in patients with aged, handicapped, bedridden, and impaired consciousness. However, small number of dialysis centers explained about *death with dignity* and *advanced directives*. In Japan, over time, discussion about *death with dignity* and *terminal care* had been avoided. ***Aim:*** To clarify the recognition levels about "Right to Die" and "Living Will" in patients on dialysis. ***Method:*** We investigated the recognition levels of "Living Will" and "Right to Die" in patients on dialysis. The questionnaire survey about the recognition of "Right to Die" and "Living Will" was performed to 149 maintenance dialysis patients in the Tamura Memorial Hospital in Chiba Prefecture and 53 maintenance dialysis patients in Tokorozawa Kidney Clinic in Saitama Prefecture. ***Results:*** As a result, the patient over 70% had recognition concerning necessity of "Living Will" and "Right to Die" in each clinic. In addition, having the hope for "Right to Die" in the state of the end became clear in the patient of 70%. However, the recognition of the medical treatment person side to it is a situation in which it is insufficient, and not performed a religious backup. In addition, the system of informed consent about "Right to Die" and "Living Will" is poor. ***Conclusions:*** The recognition of maintenance dialysis patients about "Living Will" and "Right to Die" is extremely high in Japan. However, small number of dialysis centers explained about *death with dignity* and *advanced directives*. In Japan, it comes at time to discuss about terminal care in patients on dialysis more seriously.

Pediatrics

Use of Ionic Dialysance to Calculate Kt/V in Pediatric Hemodialysis

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Objective: On-line clearance (OLC) monitor measures conductivity difference between dialysate entering and leaving the dialyzer, with different electrolyte concentrations. The derived ionic dialysance then represents effective urea clearance (KECN), from which Kt/V is calculated. This allows for Kt/V to be monitored at every treatment without blood sampling. Although widely used in adults, use of ionic dialysance has not been reported in pediatric hemodialysis (HD). Our objective was to test ionic dialysance accuracy in children on HD and provide recommendations for its use in this population. ***Methods:*** Thirty-eight HD sessions in 11 patients (13–19 years; 6 M, 5 F; weight 33–55 kg) and 140 calculated Kt/V results were studied. Fresenius machines 2008 K with built-in OLC monitors were used. To calculate Kt/V from ionic dialysance, urea distribution volume (V) is needed as an input. Three methods of V estimation were used: Mellits and Cheek (MC), 27 ± 4 L; total body water nomograms (TBWN), as recommended by KDOQI, 24 ± 3 L; V derived from OLC independent from tested HD sessions, 20 ± 5 L. Reference Kt/V was calculated as sp Kt/V from predialytic and post-HD BUN from blood samples, using urea kinetic modeling. This sp Kt/V was then compared with Kt/V calculated from KECN derived from OLC and representing K, duration of HD session t and 3 different Vs, providing 3 groups of Kt/V results: (1) Kt/V-MC, (2) Kt/V-TBWN and (3) Kt/V-OLC. ***Results:*** spKt/V was 1.68 ± 0.22, 1.24 to 2.26, n=38; Kt/V-MC was 1.23 ± 0.15 (n=38, %bias 25.88 ± 10.64, r=0.292, $P<0.01$), Kt/V-TBWN was 1.37 ± 0.16 (n=38, %bias 17.33 ± 11.55, r=0.264, $P<0.01$), and Kt/V-OLC was 1.70 ± 0.21 (n=26, %bias 7.86 ± 6.15, r=0.642, $P>0.05$). ***Conclusions:*** Ionic dialysance accurately calculates Kt/V in pediatric HD patients when V is estimated by OLC. The TBWN method for V estimation results in more accurate Kt/V than if using MC formulas, but consistently underestimates Kt/V. The TBWN method can be used if average difference of 0.3 in Kt/V is accounted for. This is the first study of use of ionic dialysance in children and it provides recommendations for accurate use. On-line clearance monitoring of each HD session allows timelier optimization of HD without blood samples. The ability to provide timely feedback is especially important in pediatrics where monthly assessments may be insufficient.

Preliminary Examination of Medical Traumatic Stress Symptoms in Pediatric Dialysis Patients and Their Caregivers

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Diagnosis of end-stage renal disease and initiation of dialysis (ID) can be upsetting and life-altering for children and caregivers. Dialysis can be painful and life-threatening events may occur (e.g., myocardial infarction, severe HTN) leading to distress and potential traumatic stress. Recent research in pediatric medical populations has demonstrated that children and their caregivers may experience significant traumatic stress, i.e., medical traumatic stress (MTS), when faced with life-threatening and serious chronic illnesses and dealing with burdensome and invasive treatments. Medical traumatic stress can include psychological and physiological symptoms similar to PTSD of hyperarousal, re-experiencing/intrusiveness, and avoidance resulting in poor adjustment and coping. To date, no one has investigated MTS in the pediatric dialysis population and its impact on patient and caregiver functioning. Now underway is a retrospective study of patient and caregiver recall of MTS symptoms associated with ID utilizing a modified version of a commonly used self-report PTSD symptom checklist (UCLA-PTSD reaction index). Preliminary data are available from 28 of our patients (mean age 16.5 years; 82.4% male; 9 HD, 3 home HD, 6 PD, 10 TX) and 16 caregivers (10 patient-caregiver dyads). Time since ID ranged from 3 to 126 months with just over half of the patients (13–22 years) recalling ID as traumatic. A majority of caregivers recalled these events as traumatic for themselves and for their children producing significant fear and helplessness. Two caregivers (11.8%) and 2 patients (8.7%) met criteria for a PTSD diagnosis based on endorsed symptom frequency and severity. Examination of PTSD symptom clusters reveal that significantly more caregivers (76.5%) than patients (40%) recalled dissociation (i.e., felt as if events were not real; $\chi^2 = 4.98$; $P = 0.03$) and intrusive symptoms (e.g., bad dreams, upsetting memories; see Table 1), with both groups experiencing arousal symptoms (e.g., difficulties sleeping, hypervigilance) to less of a degree. Avoidance symptoms (e.g., avoiding thoughts, people associated with dialysis) were least recalled.These results suggest that diagnosis of end-stage renal disease and ID is associated with MTS in some patients and caregivers. Screening for MTS in pediatric patients ID and caregivers may be warranted prompting early intervention efforts, which may improve at-risk patient and caregiver adjustment and functioning.

Table 1 Summary of preliminary data on recall of PMTS associated with initiating dialysis

Respondent	PMTS total severity score average (range)	PMTS severity scores ≥ 38*	Dialysis as traumatic N (%)
Caregiver Self-report	21.29 (1–55)	4 (23.6)	13 (76.5)
Caregiver proxy	19.33 (2–66)	2 (13.4)	10 (62.5)
Patient self-report	15.48 (3–49)	2 (8.6)	12 (52.2)
	Symptoms most frequently recalled N (%)		
Respondent	Intrusion/ re-experience	Avoidance	Arousal
Caregiver Self-report	10 (58.8)**	2 (11.8)	6 (35.3)
Caregiver proxy	5 (33.3)	2 (13.3)	4 (26.7)
Patient self-report	5 (21.7)	2 (8.7)	4 (17.4)

*Severity score cutoff ≥ 38 indicative of possible PTSD.
**$\chi^2 = 6.07$ ($P = 0.05$).

Nurse-driven Initiative to Improve AV Fistula Rates in Pediatric Patients

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Background: Arteriovenous (AV) fistulas are considered the ideal permanent vascular access in hemodialysis patients. Advantages associated with AV fistulas are decreased incidence of infection and clotting, improved dialysis adequacy, decreased hospitalizations, and improved patency rates. Permanent access in the pediatric population presents unique challenges due to the size of the patient and lower blood pressures can make the placement and on-going patency of the AV fistula difficult. ***Purpose:*** The purpose of this project was to increase the number of AV fistulas placed in pediatric patients receiving hemodialysis in 2010 at a tertiary pediatric hospital. ***Methods:*** Nurse driven initiatives involved the following:

- Multidisciplinary monthly Quality Assessment Performance Improvement (QAPI) meeting to review AV fistula rates and development of strategies for improvement
- Early scheduling for AV fistula surgical evaluation
- Comprehensive patient/family education
- Utilization of a child life specialist for support of the patient undergoing cannulation 3 times a week
- Extensive staff education and training related to assessment of AV fistulas and cannulation techniques
- Development of new AV fistula policy and procedure to address development of the nurse's skill level in the cannulation of AV fistulas that are less mature
- Implementation of formal surveillance process to identify AV fistulas that are not functioning optimally.

Results: Improvement in usable AV fistula rates from 25% in 2009 to 72% YTD 2010. Decrease in bacteremic events from 4.23 events/1000 HD (hemodialysis) days in 2009 to 0.94 events/1000 HD days YTD 2010. ***Discussion:*** Variation in RN skill mix required creating appropriate staffing patterns and increased nurs-

ing time. Participation of patients in education of fellow patients. ***Conclusion:*** Exceeded fistula first initiative of 66%. Reduction in bacteremic events per 1000 HD days.

Implementation of a Blood Volume Monitoring Protocol Using a Quality Improvement Model in a Pediatric Dialysis Unit

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Introduction: Pediatric hemodialysis (HD) patients are at risk for development of severe left ventricular (LV) hypertrophy, which is a known risk factor for cardiovascular mortality in adults. Hypertension and chronic volume overload are 22 of the most significant risk factors for development of LV hypertrophy. Estimating and achieving dry weight in pediatric HD patients is a difficult process due to many reasons and is made more difficult due to pediatric patients' growth on dialysis that is not seen in the adult population. Through the use of noninvasive monitoring (NIVM) of the hematocrit, a more accurate method of estimating the dry weight has been established. ***Rationale:*** Our goal is to improve the overall health of chronic hemodialysis patients in the pediatric dialysis unit by implementing a change package of evidence-based strategies to optimize dry weight and volume control. Goals of this project include decrease in intradialytic symptoms, accurate documentation of dry weight assessments each month, standardized blood volume monitoring (BVM) protocol using the hematocrit monitor, and documentation of ultrafiltration rate changes which will include rationale for these changes based on BVM. ***Methods:*** To achieve this, the model for improvement and rapid cycle PDSA's before implementation of change ideas will be utilized. We will implement a standard BVM protocol, perform monthly (minimum) dry weight assessments of all pediatric HD patients, and improve documentation of changes and patient response during ultrafiltration. Measurements will include percent decrease in intradialytic symptoms, percent of dry weight assessments performed each month at a minimum, percent of time the standardized BVM protocol is used with patients receiving ultrafiltration and percent of time documentation for ultrafiltration rate changes and description and rationale for changes. ***Results:*** This protocol was implemented in July 2010 and to date we have shown that 100% of patients who are being ultrafiltrated are placed on the BVM protocol. Ninety percent of medical records reviewed demonstrated documentation of BVM readings and changes in ultrafiltration rate in accordance with the protocol. In terms of blood pressure control, we have seen that 50% of eligible patients have documented improvement in predialysis blood pressure readings. Review of intradialytic symptoms has shown a decrease from 12% of patients with documented intradialytic symptoms (nausea, vomiting, hypotension, dizziness, muscle cramps, etc.) to 7.6%. ***Conclusions:*** Ongoing analysis will confirm these preliminary findings leading to our goal to improve the overall health of our chronic pediatric hemodialysis patients. This project highlights the utility of rapid cycle PDSA in quickly impacting clinical outcomes.

Estimation of Pediatric Standard Kt/V from 30-Second BUN: Concordance with a Gold Standard

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Background: Previously we derived standard Kt/V (standard Kt/V) values for children on thrice-weekly hemodialysis (HD) using the gold standard of a 30-second and 15-minute post-HD BUN eKt/V equation (Goldstein). Despite its theoretical benefit, the need for obtaining a 15-minute sample may be onerous for patients and dialysis units. ***Purpose:*** Determine the accuracy and concordance of pediatric standard Kt/V values derived using only 30-second BUN samples as compared with Goldstein's eKt/V. ***Methods:*** Four published adult eKt/V equations (Table 1), which use only 30-second BUN values, were compared with Goldstein's eKt/V from 399 chronic HD runs. All standard Kt/V values were calculated by Leypoldt's standard Kt/V formula & rounded to the nearest 0.1 U. Sensitivity, specificity, positive and negative predictive values were calculated for standard Kt/V estimated by the 4 adult-based formula in comparison with Goldstein derived standard Kt/V at the cut-off of ≥ 2.2 (equivalent to spKt/V ≥ 1.4). ***Results:*** See Table 1. ***Discussion:*** As individual or unit underdosing of dialysis would generally be of most concern, we considered positive predictive values to be the most valuable metric. Based on criteria, all formula as applied performed well in comparison to eKt/V (Goldstein) with PPV $\geq 85\%$. For most pediatric HD units, we suggest that any of the 30-second post-BUN equations provide an acceptable substitute for Goldstein's eKt/V in monthly monitoring of standard Kt/V. However, given the current values observed, we suggest Goldstein derived standard Kt/V still be used for outcome studies. Future analysis is planned around issues of access specificity as both the Tattersall and Daugirdas eKt/V formula also account for arteriovenous fistula/arteriovenous graft vs. catheter use.

Table 1 Concordance with standard Kt/V calculated based on Goldstein's eKt/V

eKt/V Eq.	Leypoldt	Tattersall	Daugirdas	Maduell
Sensitivity	84.4	90.9	86	85.2
Specificity	85.3	76.3	83.3	84
PPV	89.9	85.7	88.9	89.2
NPV	77.8	84.4	79.1	78.4

Otoneurological Evaluation in Children and Adolescents on Hemodialysis: Preliminary Data

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Background: Patients with chronic kidney disease can develop several systemic side effects. Neurologic and hearing complications can be frequently seen, however, they are not routinely accessed. The aim of our study was to investigate hearing and vestibular functions in pediatric patients on hemodialysis. ***Methods:*** We evaluated patients from 5 to 16 years old on hemodialysis. All of them were submitted to otologic inspection, audiological screening (audiometry and imitanciometry) and vectoelectronystagmography (vestibular balance evaluation). ***Results:*** Ten patients were eligible for the study, 5 male and 5 female, from 5 to 16 years old, all of them on hemodialysis at the same pediatric center. Audiometric evaluation showed moderate neurossensorial unilateral hearing loss in 1 patient (10%), all of them showed type A tympanograms (normal), 40% of the patients had alterations in vestibular assessment—3 with peripheral vestibular syndrome and 1 (10%) with irritative type peripheral vestibular syndrome. ***Discussion:*** Even though hearing impairment is frequent in chronic kidney disease patients, there are few large studies looking at this subject. Dizziness is not an unusual complaint, but is more associated to hypotension. ***Conclusion:*** Our study suggests that we should take more careful look to the otoneurological evaluation. Vestibular assessment by vectoelectronystagmography appeared as a sensible method in pediatric patients and should be used routinely in order to help improving their quality of life.

Tandem Plasmapheresis and Hemodialysis in a Pediatric Dialysis Unit

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The simultaneous application of plasmapheresis (PE) and hemodialysis (HD), known as tandem PE and HD (TPH), is useful in patients who necessitate both techniques: however, little experience exists about its use in pediatric dialysis units. We retrospectively reviewed the TPH sessions performed in the last 5 years in our institution. There were 67 TPH treatments in 7 patients, median age 16.2 years (range 5–34), median weight 37 kg (17.0–59.0). Indications for TPH were atypical hemolytic uremic syndrome in 64/67 sessions, vasculitis, focal segmental glomerulosclerosis (immediately before kidney transplantation) and hyperimmunization in patients waiting for a kidney transplant in the remaining 3 sessions. In all of the cases Gambro AK 200 ultra machine was used for HD and Baxter BM 25 device for PE. Fresh frozen plasma was used as substitution fluid in most treatments (64/67), albumin diluted in Ringer lactate in the other 3 sessions. An arterovenous fistula was used as vascular access in 5 patients, whereas 2 children used either percutaneous or tunneled central venous catheters. We prescribed for HD the dialyzers that patients have been currently utilizing (surface area 0.3–1.8 m^2). Peritoneal exchange was performed using the Gambro PF2000N Plasmafilter (0.3 m^2). The HD circuit was first connected and the ultrafiltration started. Hemodialysis blood flow rates (HD QB) was maintained in the usual range of the patient. When cardiocirculatory parameters were stable, the PE circuit was connected by means of a U-shaped connector positioned immediately before the venous access of the patient. Blood pump velocity of the BM25 device was set at 30% to 70% of the HD QB. No supplemental heparin was added to the circuit, compared with the usual dose of HD. The exchange volume was 100% to 150% of the plasma volume. No calcium gluconate infusion was prescribed. In 66/67 treatments TPH was successfully completed. Only one treatment was complicated by a hypotensive episode, in a 31-year-old woman, whose past history was characterized by recurrent intradialytic hypotensive episodes. We conclude that TPH is a safe and well-tolerated procedure, even in children and adolescents with stable cardiocirculatory conditions.

Dialysis Headache Due to Dialysis Disequilibrium Syndrome Related to a Medulloblastoma

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A 5-year-old boy with end-stage renal disease due to congenital anomalies of the kidney and urinary tract was shifted from peritoneal dialysis, performed since the age of 6 months, to hemodialysis (HD) because of recurrent peritonitis. Since his first treatment he complained of headache during the HD sessions: the headache had frontal location and throbbing quality, had its onset 1 hour after the beginning of HD and ended with the end of HD treatment. Nausea and vomiting were sometimes associated. Dialysis prescription was adequate and predialysis azotemia was 140 mg/dL. Intradialytic mannitol infusion, sodium profiling and reduction of blood flow rate proved unsuccessful in improving the symptoms. Dialysis headache, supported by familiar susceptibility to migraine and normal neurological examination, was initially hypothesized. One month after the first HD-related headache, short episodes of mild headache began to appear occasionally out of the HD sessions. Brain computer tomography and magnetic resonance imaging showed a triventricular hydrocephalus and a median large cerebellar mass. A radical surgical resection of the mass was performed, leading to the diagnosis of medulloblastoma. After surgery, no more headaches occurred. To our knowledge, this is the first report of a medulloblastoma presenting with dialysis disequilibrium syndrome (DDS). Disequilibrium syndrome is the clinical manifestation of an acute neurological dysfunction, attributed to cerebral edema occurring during HD treatment. An

intradialytic increase of intracranial pressure was shown in these patients, due to the so-called "reverse osmotic gradient": during HD, the clearance of organic osmolytes is slower across blood-brain barrier than across HD membrane, generating an osmotic gradient that produces water movement into brain cells. In our patient the compensatory reserve had to be low, because of the cerebral mass. In conclusion, when evaluating patients who develop neurological symptoms during HD treatment, disequilibrium syndrome must be differentiated from simple dialysis headache, the former presenting with symptoms of intracranial hypertension. Disequilibrium syndrome can hide causes of reduced compliance of intracranial compartment, like intracranial tumors: in such cases, paradoxically, HD allows for an earlier diagnosis of intracranial lesions.

Sleep Disturbances in Pediatric Patients on In-Center Hemodialysis

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Sleep disturbances, such as sleep-related breathing problems (SRB), restless leg syndrome (RLS), and periodic limb movements during sleep (PLMS), are commonly reported in adult dialysis patients, with a prevalence of 60% to 80%. One study in pediatric dialysis patients revealed that 86% of children undergoing dialysis-endorsed sleep disturbance symptoms. In our dialysis population at Texas Children's Hospital, fatigue was a common complaint noted on Health-Related Quality-of-Life (HRQOL) assessments. As a result, the Pediatric Sleep Questionnaire (PSQ) is currently being administered as part of an ongoing Quality Assessment and Performance Improvement Initiative (QAPI) to screen for sleep-related difficulties in our in-center hemodialysis population. Caregiver and/or patients were individually interviewed using the PSQ to determine risk of SRB, excessive daytime sleepiness (EDS), PLMS, and insomnia (INS). Behavioral and environmental factors associated with disturbed sleep patterns were also assessed. Patients were excluded if on dialysis for <2 months. Preliminary data on 16 patients (62.5% male) with an average age of 16.31 years (mean 7–22 years) are currently available. Two patients were identified as meeting criteria for a suspected sleep disorder (i.e., criteria met on 1 of 4 domains screened) with 4 patients (25%) identified as being at-risk for PLMS. None were identified as being at-risk for SRB disorder. Of note, a subthreshold level of PLMS symptoms were endorsed by 4 patients with 2 of these (plus 1 additional) patients also endorsing a subthreshold level of SRB symptoms. Daytime sleepiness, complaints of daytime sleepiness, and commonly taking a daytime nap were endorsed by 25%, 44%, and 63% of patients, respectively. Five patients rated 2 or more ADHD symptoms as notably problematic with nearly 38% (6) falling sleep with the TV on, 31% (5) falling asleep with music on, and 19% (3) having background noise interfering with sleep. These preliminary results, on nearly 50% of our in-center HD patients, support findings from previous research on sleep problems in pediatric end-stage renal disease and provide initial evidence that screening for sleep difficulties in pediatric dialysis patients should be part of HRQOL assessment. Screenings can identify need for sleep study referrals and inform dialysis unit initiatives to offer education and strategies for improving sleep quality in our patients.

Pica: An Important and Unrecognized Problem in Pediatric Dialysis Patients

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Background: Pica, defined as the compulsive consumption of nonnutritive substances, is thought to be increased in the dialysis population. Little is known regarding the incidence or the metabolic complications resulting from pica, particularly in children. ***Objective:*** The purpose of our study was to determine the prevalence of pica among patients in our pediatric dialysis center. ***Design/Methods:*** Eighty-seven patients followed on chronic dialysis therapy were surveyed for consumption of nonnutritive substances. Those with pica were assessed for demographic, nutritional, and metabolic characteristics. Dialysis efficiency was estimated by calculating urea clearance per patient volume (Kt/V). Sixty-seven (76%) patients were receiving hemodialysis (HD) 3 to 4 times weekly on hollow fiber dialyzers. Twenty (23%) patients were maintained on peritoneal dialysis using nightly cycling (CCPD). ***Results:*** The patients' mean age was 17.2 ± 7.2 years. The race/ethnicity of the population was predominantly nonwhite (93%). Dialysis efficiency reflected by Kt/V averaged 1.5 ± 0.5. The survey indicated that 46% of patients experienced some form of pica, divided into simple "ice" pica (34.5%) vs. "hard" pica (12.6%). Hard pica included the compulsive consumption of chalk, starch, soap, sand, clay, Ajax cleanser, sponge, and potting soil. Those on HD were 8.3 times more likely to have hard pica compared with those on CCPD. Greater than 5 years on dialysis was associated with a 3.2 odds ratio (OR) of having pica ($P=0.02$). Anemia was the most significant morbid association with pica, occurring at an OR of 4.4 ($P=0.001$) for all pica and 6.5 ($P=0.02$) for hard pica. Once pica initiated, an "addictive" nature to the consumption became apparent. Intervention consisted of behavioral modification employing substitution strategies by child psychology. ***Conclusion:*** Our data indicate that pica is a prevalent and potentially harmful affliction that needs further attention in the nutritional management of dialysis patients.

Effect of Varied Dialysate Bicarbonate Levels on Phosphate and Potassium Removal: A Pilot Study

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Background: Elevation of serum phosphate (P) and potassium (K) is common in dialysis patients. Alkalosis shifts P and K into

erythrocytes, and may reduce removal during dialysis. Therefore, lower bicarbonate dialysate might increase their removal with hemodialysis (HD). ***Objectives:*** Compare P and K removal in serum and dialysate during HD with low (28 mmol/L) and high (38 mmol/L) dialysate bicarbonate concentrations. ***Methods:*** Stable children on maintenance HD with an elevated predialysis serum P were studied. Each patient was evaluated as follows; 1 week with low dialysate bicarbonate, 1 week with high dialysate bicarbonate, 1 week washout between the cross-over. Each dialysis session was standardized and consistent except for dialysate bicarbonate. All patients continued their prescribed P binder. Mean serum P, K, and bicarbonate levels of each predialysis, postdialysis-, and 1 hour postdialysis treatment values are presented. Dialysate P and K levels are mean of q30-minute aliquot samples during each dialysis. ***Results:*** Six patients, aged 16.0 ± 2.5 were studied (4/6, male).

Dialysate [HCO_3]	High	Low	P
Serum predialysis			
PO_4 (mmol/L)	1.8 ± 0.4	1.8 ± 0.3	0.99
K (mmol/L)	4.4 ± 0.4	4.6 ± 0.4	0.02
tCO_2 (mmol/L)	24 ± 2	21 ± 1	0.02
Serum Postdialysis			
PO_4 (mmol/L)	1.0 ± 0.3	1.2 ± 0.3	0.16
K (mmol/L)	3.0 ± 0.2	3.5 ± 0.3	0.01
tCO_2 (mmol/L)	29 ± 3	23 ± 2	0.02
Serum 1 hour Postdialysis			
PO_4 (mmol/L)	1.20 ± 0.2	1.4 ± 0.3	0.08
K (mmol/L)	3.37 ± 0.4	3.9 ± 0.5	0.02
tCO_2 (mmol/L)	30 ± 4	23 ± 1.9	<0.01
Dialysate Excretion			
PO_4 (mmol)	0.23 ± 0.08	0.23 ± 0.08	0.89
K (mmol)	1.54 ± 0.40	1.74 ± 0.23	0.07

Conclusion: This study failed to demonstrate that lower bicarbonate dialysate content increases P and K removal.

You Can Do It: Educational Incentive Project for Children on Hemodialysis

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Background and Purpose: We identified a need for a quality improvement project to help improve patient's knowledge of their medical regimen focusing on assigned dialysis on-time, avoidance of extra dialysis treatment time due to excess fluid weight gain, and knowing goal potassium and phosphorus levels. We routinely had been using "report cards" to discuss patient's progress with their medical regimen each month in clinic. However, this was not motivating our patients to improve their compliance with their medical regimen. This incentive project focused on positive reinforcement and allowed the staff to play a more active role in educating and rewarding the patients for their accomplishments. ***Methods:*** Before introducing the project to the patients, our child life specialist provided education to our interdisciplinary team to discuss developmentally appropriate ways to communicate with and to teach patients. Next, the patients painted self-portraits to be displayed in the dialysis unit to create a team feeling and to reinforce the "we can do it" concept. Nursing, dietary, and child life staff introduced the goals to each patient. Goals included recognizing target potassium and phosphorus levels, minimizing interdialytic weight gains, and adhering to their assigned dialysis schedule. Potassium levels were checked before dialysis and predialysis weights were checked to determine interdialytic weight gains. Phosphorus levels were checked intermittently and patients were rewarded if the level was decreased from previous labs or remained within goal range. Patients were also rewarded if they came to dialysis treatments on time. Rewards for each goal achieved were colored poker chips that each patient wrote his name and achieved goal on and placed into a clear bucket. The chips provided a reward that was visible as the team watched the chips build up in the bucket, tactile as patients touched and wrote on the chips, immediate personal reinforcement, and team effort to motivate. Once the bucket was full, the entire dialysis unit received a cotton candy party for reaching their goals as a team. ***Results:*** Child life was very helpful to the team in facilitating communication and educating patients. This project helped us recognize that many patients did not know their potassium, phosphorus, or fluid intake goals. The project helped improve staff, patient, and family communication. Families and patients were more engaged with their interdisciplinary team. This project helped individuals identify problems they had with their medical regimen and work toward improving compliance in a fun and positive manner.

Plasma Exchange for Patients with Steroid-Resistant Nephrotic Syndrome

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Plasma exchange is one of the possible treatment strategies for steroid-resistant nephrotic syndrome (SRNS), in particular when associated to focal segmental glomerulosclerosis. Most of the patients with SRNS become resistant to diuretics and the management of their fluid overload sometimes becomes a major clinical challenge. We describe here our experience with combining ultrafiltration together with plasma exchange (PEX) aimed at removing part of the fluid overload in 1 child with SRNS. A 10-year-old boy with a working weight of 36 kg, currently weighing 39 kg, with SRNS underwent PEX treatment (using a Baxter BM11—14 device) with a substitution of 150% of plasma volume (3000 mL of 4.5% albumin solution in Ringer Lactate) in 3 hours. Heparinization schedule was 2000 U at the beginning

followed by 1000 U/h. On the arterial line, just before the plasma filter (Gambro PF2000N), a hemofilter (Edwards Lifesciences HF 0.3) was placed, with a single line out for collecting and measuring ultrafiltrate. Relevant biochemistry at beginning of the procedure was hematocrit 25.6%, sAlbumin 1.9 g/dL, and sCreatinine 0.9 mg/dL. The session was well tolerated, no unexpected complications were recorded, patient's hemodynamics was stable and the procedure provided 650 mL of ultrafiltrate (4 mL/min). Hematocrit (monitored by CritLine2000) remained stable throughout the entire session. Based on this very limited experience, the combination of ultrafiltration and PEX is feasible, safe and efficacious and it can represent an additional tool whenever fluid removal is necessary in patients unresponsive to diuretics and requiring PEX.

Quotidian HD

Nocturnal In-Center Hemodialysis: A Pilot Program Becomes an Alternative Therapy Option—Logistic Issues and Improved Clinical Outcomes

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A pilot in-center nocturnal hemodialysis (NHD) program to evaluate the logistics and feasibility for alternative extended hour therapy was started in January 2009. A total of 21 patients were enrolled, providing 247 patient months of experience. Two patients died (1 withdrawal, 1 cardiac) and 1 transferred to home HD. Thrice weekly 8-hour HD was offered to patients on conventional HD. Recruitment was easily achieved via meetings explaining to interested patients and families the purpose of the pilot. Reasons to switch to nocturnal were not doing well on current therapy (12/21), physician initiated (2/21), excess fluid gains (1/21), benefits of longer dialysis (4/21), employment (1/21), and 1 transfer from another nocturnal program. The major operational issue was recruiting and retaining the RN staff for nocturnal schedule. Clinical outcome measures improved during 12 months of NHD 97% albumin 3.5 g/dL compared with 86% in the previous 12 months; 62% of phosphate values <5.5 mg/dL compared with 46% prior; mean standard Kt/V before starting NHD was 2.5 ± 0.4 and increased to 2.8 ± 0.3 on NHD. While maintaining Hb levels (prenocturnal 11.8 ± 1.2; NHD 12.3 ± 1.5 g/dL) ESA utilization decreased over time reaching a 62% lower epogen dose per treatment by month 12 ($P=0.0002$). Quality-of-life assessment by KDQOL-SF36 at 6 months compared with baseline ($n=14$) showed improvements in energy/fatigue ($P=0.04$), effect of kidney disease ($P=0.05$) and patient satisfaction with delivery of end-stage renal disease care ($n=0.009$). Patients on center NHD experience significant improvement in QOL. Challenges in implementation of nocturnal programs as part of routine end-stage renal disease care are outweighed by improved outcomes including decreased drug utilization.

Quotidian Long and Short Home Hemodialysis: Factors Associated with Patient and Technique Survival

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Background: We studied 9 patient and 11 dialysis factors and their association with patient and technique (uncensoring for return to 3/wk HD) survival in 81 patients on long night (>5 hours) and 110 on short day (<5 hours) surviving >3 months on QHHD followed for 452 patient-years. ***Patients:*** The mean age was 54 ± 14 years, 39% were black, 66% males, 50% had secondary renal disease (23% had diabetes). They had been on end-stage renal disease treatment for 4.7 ± 4.9 (range 0–25) years before HHD. Patients on long QHHD were older (57 vs. 53 years, $P=0.024$) and more often Afro-American (49% vs. 27%, $P=0.013$). ***Methods:*** Cox proportional hazards analyses, Kaplan-Meier analyses. $P<0.05$ significant, $P<0.1$ borderline. Confidence intervals (CI) 95%. ***Results:*** Of the patients, 99 (52%) remained on daily HHD, 34 (18%) were transplanted, 31 (16%) returned to 3/wk HD and 27 (14%) died. Five-year patient survival was $71 \pm 6\%$ (long $79 \pm 7\%$, short $69 \pm 9\%$, $P=0.024$). Five-year technique survival was $80 \pm 4\%$ (long $93 \pm 3\%$, short $46 \pm 17\%$. $P=0.001$). In univariate Cox proportional hazards analyses; dialysis hours, weekly dialysis hours, Kt/V, and standard Kt/V were significantly associated with better survival and young age and primary renal disease borderline associated. Older age, secondary renal disease, late era of start of HHD, dialysis hours, weekly dialysis hours, Kt/V and standard Kt/V were associated with better technique survival. In backward stepwise Cox proportional hazards analyses: patient survival was independently associated only with age (HR=1.03, CI=1.00–1.06, $P=0.023$) and hours of each dialysis (HR=0.64, CI=0.50–0.82, $P=0.003$) and technique survival with secondary renal disease (HR=0.37, CI=0.17–0.80, $P=0.011$) and weekly standard Kt/V (HR=0.37, CI=0.28–0.68, $P=0.0002$). ***Conclusions:*** In quotidian HHD, longer hours of dialysis is associated with better patient survival and higher dose of dialysis with better technique survival. Long night hemodialysis appear superior to short-daily hemodialysis.

A Successful Term Pregnancy Using In-Center, Intensive Quotidian Hemodialysis

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Background: Conventional hemodialysis (CHD) in pregnancy is associated with poor fetal survival, lower birth weights, and high preterm delivery rates. Even in women who conceive before commencing dialysis, fetal loss is up to 26% and preterm delivery rate 74%. Current guidelines recommend more intensive dialysis, at

least 20 h/wk. Improved pregnancy outcomes have been reported with nocturnal hemodialysis (NHD); this effect has been attributed to the superior blood pressure control and uremic clearance with this modality compared with CHD. Following from the principles of the nocturnal dialysis experience in pregnancy, we report on a case of a successful pregnancy from an in-center hemodialysis setting. ***Case:*** A 30-year-old primagravida with chronic kidney disease secondary to reflux nephropathy became pregnant. Losartan was discontinued at 5 weeks gestation with no recurrence of hypertension during pregnancy. At 9 weeks gestation, eGFR of 14 mL/min/1.73 m^2, she commenced a NHD-type prescription, performed in-center for logistical reasons. She received 36 hours of dialysis/wk. Biochemical parameters were maintained within a physiological range. Anemia was treated with increased darbepoetin and iron. Supplementation of phosphate was required. Fetal development was normal. At 39 weeks, she had a spontaneous labor and vaginal delivery of a healthy 3000 g infant. She required on-going HD after pregnancy. ***Discussion:*** Our case provides an example of how an in-center intensive quotidian hemodialysis prescription can result in a successful pregnancy. If this outcome is reproduced, women with advanced chronic kidney disease or end-stage renal disease may be provided better guidance during pregnancy especially when nocturnal hemodialysis is not available or feasible. Our experience is consistent with more recent literature suggesting 35 to 45 h/wk of hemodialysis is associated with the best maternal and fetal outcomes.

Composition of Home Hemodialysis Patients in a Large Dialysis Organization in the United States

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Background: Home hemodialysis (HHD) provides improved quality of life and potential survival benefit. But, in the United States, <2% of end-stage renal disease patients received HHD in 2008. Given its strong commitment to this modality, DaVita Inc. started an At-Home program to offer patients home choices beyond peritoneal dialysis. At-Home broadened the access to patients who may quality of this innovative dialytic therapy and created modality option educational tools to ensure successful matching. At-Home is now the largest HHD program in the world. ***Methods:*** Comparison of the composition of DaVita HHD patients to the national HHD sample using retrospective data and the 2010 United States Renal Data System (2008 USRDS) Annual Report. DaVita Inc. patients were included if they had an HHD treatment recorded in the month specified. ***Results:*** The HHD program has consistently grown over the past 3 years (Table 1) and made up 48.6% of the prevalent HHD population in the United States in 2008. ***Conclusions:*** By expanding the acceptable characteristics of patients who may be suitable for HHD the program has grown to allow this important option to benefit more patients. As in other areas of medicine, the advantage of a personalized approach to modality selection is demonstrated by the success of our program.

Table 1

Characteristic	USRDS 2008*	DaVita HHD patients 12/2008	12/2009	8/2010
N	3826	1859	2267	2526
Age (mean ± SD)	N/A	52.4 ± 14.3	53.0 ± 14.3	53.3 ± 14.4
% Male	60.2	64.1	63.5	63.4
% Caucasian	65.1	62.9	63.4	61.6
% African American	30.0	27.2	27.0	28.2
% Asian, Pacific Islander	3.6	3.1	3.0	3.2
% Native American	0.7	0.6	0.7	0.9
% Hispanic	6.9	6.2	5.9	6.0
% Diabetic (primary cause)	30.8	26.6	26.8	26.7
Vintage	N/A	4.4 ± 4.6	4.7 ± 4.6	5.2 ± 4.8
BMI	N/A	28.2 ± 7.3	28.4 ± 7.3	28.6 ± 7.4

*Note for USRDS, only age range available with 46.6% being 45–64 years old.