**ABSTRACTS OF THE 35TH ANNUAL DIALYSIS CONFERENCE 2015 – VOL. 35, SUPPL. 1**

**METABOLISM NUTRITION INFLAMMATION**

**A Comparison of Glucose Fluctuation Between Automated Peritoneal Dialysis and Continuous Ambulatory Peritoneal Dialysis**

It has been reported that high glucose fluctuation is associated with an increased risk of diabetic chronic complications. A new system, called continuous glucose monitoring system (CGMS), recently came on the market for continuously measuring glucose concentrations. The aim of this study is to reveal the difference in glucose fluctuation between automated peritoneal dialysis (APD) and continuous ambulatory peritoneal dialysis (CAPD) in diabetic peritoneal dialysis patients by using CGMS.

We studied 20 diabetic peritoneal dialysis patients (16 men, 4 women, mean age 55±10 years), and CGMS was performed 23 times (11 on APD, 12 on CAPD) between April 2011 and March 2014. 16 patients had been treated by insulin, 3 patients had been treated with only hypoglycemic agents, and 1 patient had been untreated. 2 patients were Type 1 diabetics and 18 patients were Type 2 diabetics. This study was conducted over 3 consecutive days in the hospital.

The average glucose value was 164±35 mg/dl (range 116-247), and HbA1c was 5.4±0.8% (range 4.6-7.5). Standard deviation as an indicator of glucose fluctuation was 42±15 mg/dl (range 23-71). There was no significant difference in average glucose value and HbA1c between APD patients and CAPD patients. However, standard deviation was significantly lower in APD patients compared with CAPD patients (36±14.5 vs. 49.2±14.1 mg/dl, =0.03).

APD might be reduced the glucose fluctuation compared with CAPD.

**Efficacy and Safety of Iron-Based Phosphate Binder Sucroferric Oxyhydroxide in CKD Patients on Peritoneal Dialysis (PD) or Hemodialysis (HD)**

Phosphate binders are frequently required in CKD patients receiving either PD or HD. To compare the efficacy and safety of the iron-based phosphate binder sucroferric oxyhydroxide (SFO) with that of sevelamer carbonate (SEV) in patients receiving PD or HD.

In this active-controlled, open-label Phase 3 trial, 1,059 patients were randomized to SFO (1.0–3.0 g/day; n=710) or to SEV (2.4–14.4 g/day; n=349) for 12 wks’ dose titration then 12 wks’ maintenance therapy. After 24 wks, patients could be enrolled in a 28-wk extension study during which they received maintenance-dose SFO or SEV.

At baseline, 969 HD patients and 86 PD patients were randomized. PD patients were younger than HD patients (mean: 50 [PD] vs. 57 yrs [HD]), other demographics were similar. Baseline serum phosphorus levels were 7.7 mg/dl (HD) and 7.5 mg/dl (PD) in the SFO group, and 7.5 mg/dl (HD) and 6.7 mg/dl (PD) in the SEV group. Serum phosphorus levels were reduced from baseline to Wk 52 endpoint similarly in HD and PD patients receiving SFO (change: –2.2 mg/dl in both subgroups) or SEV (change: –2.0 mg/dl [HD] and –1.5 mg/dl [PD]). In both HD and PD patients, serum phosphorus control was achieved with a lower pill burden with SFO (tablets/day: 3.2 [HD]; 3.4 [PD]) than with SEV (8.7 [HD]; 8.1 [PD]). Treatment-emergent adverse events (TEAEs) were reported in 89% of HD and 86% of PD patients receiving SFO vs. 88% of HD and 93% of PD patients receiving SEV. Overall, 53% of HD and 49% of PD patients receiving SFO had gastrointestinal-related TEAEs vs. 43% of HD and 41% of PD patients receiving SEV.

SFO was similarly efficacious and well tolerated in PD and HD patients, reducing serum phosphorus to a similar extent to SEV, but with a lower pill burden.

**The Relationship Between Interleukin-6 and Hydration Status and Cardiovascular Risk in Peritoneal Dialysis Patients.**

Cardiovascular disease is the leading cause of death in peritoneal dialysis (PD) patients. High mortality in PD patients is associated with the presence of nontraditional cardiovascular risk factors, such as chronic inflammation and fluid overload. The main aim of the study was to evaluate the relationship between interleukin-6 (IL-6), overhydration, and cardiovascular risk.

The study was performed on 57 PD patients who were divided into 3 subgroups, depending on the serum concentrations of IL-6: group A – IL-6<0.8 pg/ml (15 patients; mean age 40±15 yrs), group B – IL-6 0.8-1.5 pg/ml (25 patients; mean age 61±17 yrs); group C – IL-6>1.5 pg/ml (16 patients; mean age 60±13 yrs). Serum IL-6 was evaluated using the high-sensitive ELISA test. The degree of overhydration was assessed by bio-impedance analysis (BIA) and clinical criteria (edema and hypertension). Serum concentrations of NT-proBNP and InOpin T (tNT) and echocardiography were performed to assess the presence of cardiovascular complications.

The average age in higher groups was higher with serum IL-6 (>0.003). Groups with higher concentrations of IL-6 were more overhydrated in BIA (6.0±1.0 vs. 5.1±0.8 vs. 3.9±2.0 L; <0.001). Peripherial edema occurred in 0.0% of patients from group A, 20.0% from group B, and 37.5% from group C. Systolic and diastolic blood pressures (137.1±2.3 vs. 134.3±13.9 vs. 136.8±16.8 mmHg and 85.2±13.8 vs. 80.0±11.2 vs. 79.6±11.1 mmHg) were comparable in the groups. Serum tNT concentrations were higher in the groups with higher IL-6 (0.02±0.01 vs. 0.06±0.07 vs. 0.13±0.14 pg/ml; <0.001). Between examined groups, significant differences were found in NT pro-BNP concentrations (172±15.68 vs. 708.1±10036 vs. 958.6±12959 pg/ml; =0.011). Surprisingly, no statistical significant differences were observed in the results of echocardiography. Serum concentration of IL-6 correlated positively with OH in BIA (r=0.42; =0.001), edema (r=0.30; =0.022), tNT (r=0.48; <0.001), NT pro-BNP (r=0.37; <0.005).

There is a correlation between serum concentration of IL-6 and hydration status and the cardiovascular risk in peritoneal dialysis patients. IL-6 seems to be a good marker for assessing the risk of cardiovascular complications in patients on peritoneal dialysis.

**Resolution of Chylothorax in a Neonatal Peritoneal Dialysis Patient with Low-Fat Formula.**

**Case History:** A large-for-gestational-age girl was born at term to a 26-y-o. G4P3 Type 2 diabetic mother with hypothyroidism. The pregnancy was complicated by polyhydramnios and maternal use of metformin, glyburide, and synthroid. Apgar scores were 8 & 9 at 1 & 5 min. Due to hypoglycemia and concerns for maternal chorioamnionitis, the baby was admitted to the NICU for monitoring. On 2nd day of life, she had an unexpected cardiac arrest. The initial serum labs showed profound electrolyte derangements and acute kidney injury (AKI), which were: Na 108, K 6.3, Cl 68, CO2 13, BUN 61, and Cr 3.4. Renal ultrasound showed normal-sized kidneys with suboptimal Doppler flows bilaterally; no clots were noted by Doppler study in the aorta and IVC.

The baby had normalization of her serum sodium and needed continued veno-venous hemofiltration (CVVHD) for ongoing anuria. With renal ultrasound evidence of small kidneys without blood flow, a peritoneal dialysis (PD) catheter was placed at 2 wks of age. After post-op day 7, the PD catheter was opened to drain and milky white effluent was noted. Fluid triglyceride level was elevated at 495 mg/dl, cell count was 1300/mm3 with lymphocytic predominance. Bacterial and fungal culture was negative; a diagnosis of chylothorax was established. There had been no surgical manipulation in the thorax other than hemodialysis catheter placement for CVVHD. Echocardiogram showed normal cardiac function. There was no evidence of obstruction across the incongruent vessels on Doppler imaging and no effusions on chest X-ray. Pancreatic enzymes were normal.

**Interventions:** The baby’s formula was switched from Similac PM 60/40 to Monogen – a low-fat formula. Within 2 days after the change, the peritoneal fluid began to clear. By day 4, the fluid had an undetectable triglyceride level. After resting the peritoneum for 5 days, we started peritoneal dialysis and advanced her prescription gradually. A week later, she was switched back to Similac PM 60/40. After 4 wks on peritoneal dialysis and fat-containing formula, the chylothorax has not recurred.

**Summary:** We report a case of chylothorax in a neonate after PD catheter insertion. The attributed cause was due to microvasculitis of the lymphatics with catheter insertion. There was complete resolution of the chylothorax on low-fat formula and peritoneal rest.

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Transcriptomics and Proteomics of Visceral Peritoneal Arterioles from Healthy and Uremic Children, and from Children on Chronic PD

Exposed to conventional PD solutions with high glucose degradation product (GDP) content, the peritoniun undergoes progressive angiongenesis and vasculopathy, compromising ultrafiltration capacity and ultimately resulting in PD failure. The underlying pathomechanisms are only partly understood, and the relative impact of uraemia versus PD has not yet been delineated.

Microdissected omental arterioles from healthy and uremic children (at time of first Tenckhoff catheter insertion) and from children treated with low and high GDP PD solution (PDS) (n=5-8/group) underwent whole transcriptome analysis (Human Sentrix 12 Expression Beadarrays, Illumina), as well as proteome analysis by high-sensitive 2D difference gel electrophoresis (DIGE saturation labelling), followed by mass spectrometric identification of differentially abundant proteins. Vessels were identified by EVG staining, structure dimension analysed by automated image analysis (Aperio), neighbored sections used for Omics.

Ureaemia induced up-regulation of 173 and down-regulation of 117 arteriolar genes (p<0.01) compared to age- and sex-matched healthy controls. In patients on low GDP PDS, 88 genes were up- and 11 genes down-regulated compared to respective uraemic controls, while in children on high GDP PDS 139 genes were up- and 17 genes down-regulated. Relative to age and PD vintage matched, low GDP PDS treated children, the high GDP treatment up-regulated 27 and down-regulated 9 genes. Gene ontology analyses revealed high GDP PDS induced changes in immunological processes, and low GDP PDS regulated processes mainly involved in the complement system. Proteomics investigated the correlation of transcript levels with actual protein abundance, and searched for candidates of posttranscriptional gene regulation processes.

A global approach to the pathomechanisms of uraemia and PD induced vascular damage by means of omics is feasible in small pediatric peritoneal tissue samples. These are devoid of preexisting confounding comorbidities and demonstrate significant regulation of numerous biological pathways by uraemia, and a predominately immune system related vascular response to high and low GDP PD solutions.

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Overhydration by Bio-impedence Spectroscopy is Associated with Increased Cardiovascular Risk Factors in Peritoneal Dialysis Patients

Background Chronic fluid overload is a recognized risk factor for mortality in patients on peritoneal dialysis (PD). Body composition monitoring (BCM) using bio-impedence spectroscopy provides a reliable and practical method for assessment of volume status in PD patients. We used BCM to measure the degree of overhydration (OH) in children on PD, and studied the association between OH and cardiovascular risk factors.

Methods: 27 PD patients, mean age 14.9±6.0 yrs and mean duration of dialysis 3.7±3.25 yrs, were prospectively studied. 2D echocardiographic parameters, namely left ventricular mass index (LVM), ejection fraction (EF), and fractional shortening (FS) were obtained. Left ventricular hypertrophy (LWH) was defined as LVM ≥ 45 g/m².7 in boys and ≥ 40g/m²² in girls ≥ 9 y.o., and as above 95th percentile for children <9 y.o. OH, extracellular water (ECW), intracellular water (ICW), total body water (TBW) were determined from BCM data. OH/ECW > 1.15 was defined as severe OH. Additionally, biomarkers of cardiovascular risk were measured. Pearson’s correlation was used to assess correlation between OH and potential explanatory variables. Stepwise multivariate regression was used to identify variables independently associated with increased LVM.

Results: Mean OH and OH/ECW were 0.6±1.1 and 7.7±14.8%, respectively. Severe OH and LWH were each present in 18.5% children. In children with LWH compared to those without, NT-ProBNP (2.6±3.5 vs. 16±14.7 ng/ml, p<0.01) and haNT-ProBNP levels (0.03±0.02 vs. 0.8±0.07 ng/ml, p<0.01) were markedly raised, and mean OH/ECW were significantly higher (20.2% vs. 4.9%, p<0.01). Increasing OH correlated with increased BMI (r=0.49, p<0.01), NT-ProBNP (r=0.32, p<0.01), and reduced FS (r=0.54, p<0.01). Significant correlation was also seen between OH and the following biomarkers: NT-ProBNP (r=0.61, p<0.01), haNT-ProBNP (r=0.65, p<0.01), and homocysteine (r=0.43, p<0.05). On multivariate stepwise regression, OH (B=8.24; p<0.01) and NT-ProBNP (B=1.5; p<0.01) were independent predictors of increased LVM.

Conclusions: Volume overload is strongly associated with novel risk factors for cardiovascular disease. Bio-impedence devices may help to identify high-risk group among PD patients.

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Persistent Hypotension in an Anephric Peritoneal Dialysis Patient

Case History: Blood pressure management is often an ongoing struggle in the care of infants on peritoneal dialysis, involving a complex interaction between the patient’s own physiology and the mechanics of the dialysis itself. In this summary, we present a 10-m.o. female with Turner Syndrome, a large multicystic dysplastic horseshoe kidney status post nephrectomy and pulmonary hypoplasia with severe hypertension soon after birth. Her BNP was elevated to >5000 pg/ml and her EKG showed 4:1-second degree heart block. Her workup revealed an aortic coarctation requiring repair by left thoracotomy. Following her repair, both her hypertension and heart block resolved, though her echocardiogram continued to show biventricular hypertrophy and complete end-systolic cavity obliteration with septal hypertrophy. There was no outflow obstruction or filling defect identified. Given the nightly fluid shifts occurring while on peritoneal dialysis, despite attempts to minimize the rate of fluid removal while avoiding fluid overload, the patient became increasingly hypotensive with systolic blood pressures between 40 and 55 mmHg requiring initiation of mидodrine up to 1.25 mg/d and discontinuation of propranolol without sustained improvement. An ACTH stimulation test revealed normal results.

Intervention: In response to her worsening hypotension of unclear etiology, fluocorticosterone was initiated at a dose of 0.15 mg twice daily at 9 kg. She continued to thrive, and her blood pressures improved by 50%-70%.

Summary: In an anephric patient, the observed increase in blood pressure and the risk of cardiovascular disease. Bio-impedence devices may help to identify high-risk group among PD patients.

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Early Initiation of Peritoneal Dialysis in an Infant with Bilateral Renal Agenesis

Case History: Bilateral renal agenesis has historically been considered incompatible with life following birth due to severe pulmonary hypoplasia. Furthermore, the use of renal replacement therapy has been limited by significant morbidity and mortality associated with dialysis in very young infants with significant pulmonary pathology. We present a case of an infant, born at 28-47 weeks gestation following a prenatal diagnosis of bilateral renal agenesis at 20 weeks gestation. Prenatal course was significant for the initiation of weekly aminoic intubations at 24 7/8 weeks and continued for 4 weeks until birth. Birth weight was 1.230 grams and she initially required CRP for respiratory support. Intervention: On DOL2, dialysis access was obtained by a skilled and experienced surgical team who used an open technique to facilitate a tight seal around the dual cuffs of the infant peritoneal dialysis (PD) catheter with simultaneous omerectomy. To avoid fluid overload, total fluids were restricted to match insensible losses at 600 ml/m²/day and low-volume manual peritoneal dialysis was initiated. PD fill volume was started at 4 ml/kg with 30-min exchanges continuously over 24 hrs to aid in clearance and fluid removal. For the first week of dialysis, fill volume was not advanced past 8 ml/kg to preserve the integrity of the catheter insertion site. Fill volume was increased by 1-2 ml every 2-3 days to a goal of 27-29 ml/kg, adjusted based on the presence of bilateral inguinal hernias and an umbilical hernia. The duration of daily dialysis was adjusted to allow for a calculated Kt/V of at least 1.8. Electrolytes were monitored carefully with TPN excluding potassium, magnesium, and phosphorus. Red blood cell transfusions were divided into 3 or 4 aliquots, with each aliquot given slowly over 3-4 hrs to minimize the fluid and potassium load. Once tolerating enteral (oral and NG tube) nutrition, breast milk was fortified with premature infant formula to 30 kcal/ml and a liquid protein supplement to provide at least 100 kcal/kg/day and 3 g protein/kg/day. Central venous access was limited to preserve vessel integrity.

Summar and Applicability to Practice: In a premature infant with bilateral renal agenesis, peritoneal dialysis was successfully initiated by DOL2 using a double-cuff infant PD catheter and low-volume manual exchanges advanced slowly, with careful management of nutritional, fluid and electrolyte intake, and bone health.

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Long-Term Dialysis and Normal Renal Function in a Patient with Methylmalonic Acidemia

Methylmalonic academia (MMA) is a rare inborn error of branched-chain amino acid metabolism, and therapy consists of protein restriction, carnitine supplementation, and hydration during metabolic decompensation. This treatment may be inadequate and renal replacement therapy may be necessary to remove methylmalonic acid. In spite of medical treatment, long-term complications, such as an extrapyramidal movement disorder or chronic renal failure, may develop in a major subset of patients, especially those with mutase deficiency. We report on a 16-yc. boy with MMA mut0. The clinical symptoms developed during the 1st wk of life. He has been managed for 13 yrs by hemodialysis and peritoneal dialysis without any serious neurological complications, and renal function is normal. During peritoneal dialysis, he suffered from recurrent pancreatitis and dialysis modality was changed to hemodialysis. Although chronic renal failure is a common complication in MMA mut0 patients, this case suggests that the excretion of MMA by dialysis may be sufficient to correct the metabolic decompensation and prevent the renal damage. It is worth investigating whether early dialysis may be an option for the management of the mut0 phenotype of MMA to prevent serious complications and improve physical growth prior to a liver transplantation.

Cushing M., Polderman N. BC Children's Hospital, Vancouver, BC, Canada.

The Nutrition Management of Hyperkalemia in Infants

Infants with CKD face a myriad of issues that impact optimal nutrition intake to support growth including uremia, anorexia, gastrointestinal reflux, fluid restriction, and elevated laboratory parameters. Currently in British Columbia there are no renal-specific infant formulas available. Therefore, options for feeding these infants are limited. Higher-than-normal energy requirements require use of hypercaloric feeds, which contribute to elevated laboratory parameters. With few options available to achieve nutrition goals for growth and development we are required to make use of available products such as standard infant formula, modular products, and adult renal formulas. When Hobbs et al investigated the use of adult renal formulas in infants with hyperkalemia, they concluded that hyperkalemic infants with CKD can be nutritionally managed on adult renal formulas. The presentation highlights our experience using an adult renal formula to meet nutritional goals in light of limited options within this population.

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Sudden Elevation of Phosphate Level in a Pediatric Patient Receiving Peritoneal Dialysis

Hyperphosphatemia is a common finding in patients with end-stage renal disease and plays a central role in the development of hyperparathyroidism. Normally, the serum phosphorus concentration is highest in infants and it decrease as the child gets older.

We present a case report of an infant with renal failure receiving nightly peritoneal dialysis that developed pseudohyperparathyroidism. This is a 2-m.o. ex 41 WGA baby boy born via spontaneous vaginal delivery at home. His past medical history is relevant for respiratory failure and pulmonary hypertension secondary to meconium aspiration. He had anuric renal failure unresponsive to albumin/Lasix infusion. Peritoneal dialysis was started on his second day of life without any complications.

His medications included Epojun, Ferrous sulfate, Polvy-sol, phenobarbital, methadone, Alivian, sodium chloride, and potassium chloride. He was receiving continuous feedings with Similac PM 60/40.

His physical exam was unremarkable. He had a peritoneal dialysis catheter in the abdomen and a triple-lumen catheter at his right internal jugular vein. Routine daily laboratory test showed no electrolytes abnormalities and stable renal function. His PTH level was 94 pg/ml. It was noted that the patient had a sudden increase in phosphate level from 3.2 mg/dl to 8.8 mg/dl over 12 hrs without any change in diet or medications. Repeated serum chemistry 4 hrs later showed a phosphorus level of 3.3 mg/dl. Calcium level was unchanged at 9.4 mg/dl. Further investigation showed that patient received alteplase 1 mg/ml through his triple-lumen catheter 1 hr before blood was drawn.

Pseudohyperparathyroidism should be suspected in any patient with sudden increase in phosphate level without an obvious explanation. Pseudohyperphosphatemia has been reported in patients with paraproteinemias, hyperbilirubinemia, hyperlipidemia, hemolysis, and high-dose liposomal amphotericin B. Sample contamination with alteplase and heparin can also lead to spurious hyperphosphatemia.

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Pleural-Peritoneal or Pericardio-Peritoneal Leak in Children on Peritoneal Dialysis — A Survey from the European Paediatric Dialysis Working Group

Background: Pleural or pericardial effusions secondary to pleuro-peritoneal (PFP) and pericardio-peritoneal fistula (PPF) are rare, but serious, complication of peritoneal dialysis (PD) and have been reported in about 1.0%-5.1% of adults on PD. The incidence of PFP and PPF in children on PD remains unknown and there are no guidelines on the subsequent renal replacement therapy for these children.

Methods: We conducted a 10-yr survey across all the European Paediatric Dialysis Working Group (EPDWO) — 15 pediatric dialysis centers from 13 European Union countries — to review the incidence, diagnostic techniques, therapeutic options, and outcome of children on chronic PD with PFP and/or PPF.

Results: 1,506 children received PD with a total of 2,580 patient-yrs on PD. 9 cases (7 of PFP, 1 each of PPF and PFP+PPF) were reported, giving a prevalence of 0.6% or 3.5 cases per 1,000 patient-yrs on PD. Age at presentation was median 0.9 (interquartile range 0.4–2.5) yrs, 8 (89%) children were <3 yrs, with 5 (54%) <1 yr. The time on PD before onset of symptoms was a median of 3.6 (1.1–11.5) mos.

Preceding peritonitis episodes were recorded in 3 (33%) with 3 to 7 episodes per patient. Pulmonary, umbilical, or ventral abdominal herniae were present in 8 (89%), 7 (78%) children underwent abdominal surgery, with a median of 27 (18–41) days before the onset of symptoms. Symptoms at presentation were respiratory distress (8/9) including 1 patient requiring mechanical ventilation, reduced UF (4/9), tachycardia (3/9) or pain (1/9), and 1 child was incidentally diagnosed on routine echocardiography. All children had signs of pleural or peritoneal effusion on X-ray and/or ultrasound. In 3 children diagnosis was confirmed by leakage of methylene blue from the peritoneal cavity into the drained pleural fluid. PFP was confirmed by MRI with intraperitoneal administration of contrast agent 1 in 1 and on ECHO in the other. 6 patients required therapeutic thoracocentesis. In 2 patients pleuradensis was performed (immediately and 2 mos after presentation, respectively).

In 4 children PD was stopped immediately after presentation; in 5 PD was transiently continued for a median of 9 (2–14) days, but was finally stopped in all patients due to ongoing pleural leak. 7 patients (including both patients with PPF) were switched to HD, 1 received renal TX, and in 1 patient dialysis was discontinued.

In Conclusion: PFP and PPF are rare in children on chronic PD, but are associated with significant morbidity, requiring a change of dialysis modality in all patients to achieve complete resolution of the peritoneal leak. Risk factors for PFP development include age <3 yrs and recent abdominal surgery.

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The Utility of Social Work Presence During Pediatric Peritoneal Dialysis Home Visits

Background: Home visits are valuable for experiencing the home environment, identifying potential problems, and supporting pediatric patients on peritoneal dialysis (PD). However, there may be a need for increased social work presence and support during clinic visits. Social workers play an essential role in assessing psychosocial needs and providing education and support to patients and families. The Children’s Hospital Association’s Standardizing Care to Improve Outcomes (SCOPE) Collaborative seeks to minimize peritonitis rates in children on PD by standardizing practices for PD catheter care. Objective: To describe changes in compliance with care practices and the impact on peritonitis rates among dialysis units participating in SCOPE. Design/Methods: Catheter care “bundles” focused on PD catheter insertion, patient/caregiver education, and follow-up were developed. Compliance with care bundles and peritonitis rates are collected monthly. Of the 29 centers participating in SCOPE, 24 provided peritonitis rates for the 12 mo prior to launch and are included in the analysis. Center-specific annualized peritonitis rates were calculated. Differences in peritonitis rates were modeled using Generalized Linear Mixed Models (GLMMs) techniques, assuming a negative binomial distribution and a natural log link function. Differences in compliance were assessed using logistic regression techniques. A random effect for PD center was included in these models to accommodate PD center-specific variability. Results: Over the first 24 mos of the collaborative, compliance with practices in the insertion and follow-up care bundles, but not the training bundle, increased significantly (Table 1). The mean annualized peritonitis rate among all 24 centers was not different pre- and post-launch [0.59 (95% CI 0.41, 0.84) vs. 0.50 (95% CI 0.36, 0.72) p=0.38]. However, 14 centers experienced a significant reduction in peritonitis rates [0.79 (95% CI 0.59, 0.97) p<0.40] (95% CI 0.30, 0.53) post-p=0.002]. Centers with improvement in peritonitis rates were significantly more likely to be compliant with the practices in the follow-up bundle than the 10 centers that had no improvement (OR 1.17 (95% CI 1.03, 1.32), p=0.014).

Table 1: Odds of compliance with care bundles over time during the first 24 mos of SCOPE

| Care Bundle | OR | 95% CI | p-value |
|-------------|----|--------|---------|
| Insertion   | 1.0390 (1.0025, 1.0769) | 0.036 |
| Follow-up   | 1.1784 (1.0889, 1.2752) | 0.0003 |
| Training    | 1.0318 (0.9955, 1.0760) | 0.1429 |

Conclusions: Reduction in peritonitis rates is associated with increased compliance with best-care practices for follow-up PD catheter care. Further efforts to increase compliance with these practices and further evaluation to determine if specific practice elements within the bundle are particularly influential will be important to minimize the risk for peritonitis in this vulnerable population, thereby identifying best-care practices.

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Increased Compliance with Follow-up Care Bundle is Associated with Reduction in Center-Specific Peritonitis Rates: Results of the SCOPE Collaborative

Background: The Children’s Hospital Association’s Standardizing Care to Improve Outcomes (SCOPE) Collaborative seeks to minimize peritonitis rates in children on PD by standardizing practices for PD catheter care. Objective: To describe changes in compliance with care practices and the impact on peritonitis rates among dialysis units participating in SCOPE. Design/Methods: Catheter care “bundles” focused on PD catheter insertion, patient/caregiver education, and follow-up were developed. Compliance with care bundles and peritonitis rates are collected monthly. Of the 29 centers participating in SCOPE, 24 provided peritonitis rates for the 12 mo prior to launch and are included in the analysis. Center-specific annualized peritonitis rates were calculated. Differences in peritonitis rates were modeled using Generalized Linear Mixed Models (GLMMs) techniques, assuming a negative binomial distribution and a natural log link function. Differences in compliance were assessed using logistic regression techniques. A random effect for PD center was included in these models to accommodate PD center-specific variability. Results: Over the first 24 mos of the collaborative, compliance with practices in the insertion and follow-up care bundles, but not the training bundle, increased significantly (Table 1). The mean annualized peritonitis rate among all 24 centers was not different pre- and post-launch [0.59 (95% CI 0.41, 0.84) vs. 0.50 (95% CI 0.36, 0.72) p=0.38]. However, 14 centers experienced a significant reduction in peritonitis rates [0.79 (95% CI 0.59, 0.97) p<0.40] (95% CI 0.30, 0.53) post-p=0.002]. Centers with improvement in peritonitis rates were significantly more likely to be compliant with the practices in the follow-up bundle than the 10 centers that had no improvement (OR 1.17 (95% CI 1.03, 1.32), p=0.014).

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**Pediatrics**

### “A3” Quality Improvement Project to Improve and Streamline Hospital Discharge Process for Infants on Peritoneal Dialysis

**Background:** Many preparations are required in transitioning infants on chronic peritoneal dialysis (PD) from the hospital setting to home setting, including ensuring that the patient’s caregivers have accurate and adequate supplies at home to care for the infant. We have experienced various logistic issues related to discharging infants on PD; therefore, we aimed to improve and streamline the hospital discharge process for these patients.

**Goals of the Project:** The goal of this project was to identify the types of problems that occur surrounding discharge, the root cause of the problem, and to prevent future similar problems.

- **Approach:** We utilized our institution’s Quality Management System (PQMS) to create an “A3,” which is a method for framing complex problems, root causes, and follow-up metrics aimed at improvement. Pediatric nephrologists, dialysis nurses, infant nurses, inpatient case worker, renal dietician, and outpatient pharmacist participated in this A3.

**Outcomes:** We identified 3 types of problems and devised solution for each type problem. Problem 1: Lack of a systematic method of keeping track of the parents' training progress.

1. Developed a bedside discharge criteria checklist which keeps track of the parents' training and supplies.
2. Created a bedside patient's Daily Binder which contains important information the parents will be referring to on a daily basis such as medications, PD Logs, and Nutrition Recipe.
3. Problem 2: Lack of communication between the inpatient case worker and outpatient dialysis team about vendor information; parents' lack of knowledge on their specific vendors for formulas and supplies.
4. Inpatient case worker emails the patient's vendor information to the outpatient team prior to discharge.
5. The vendor is included in a designated Vendor Information section in the Patient’s Daily Binder. Problem 3: Limited and unreliable availability of local compounding pharmacies.
6. Hospital fills 1 mo supply of all discharge medications and discharge medications must be at bedside on the day of discharge.
7. During the 2 mos period prior to the implementation of the A3, we had 2 problems with formula, 2 problems with vendor contact, 1 problem with supplies, and 1 problem with medication. In the 2 mos after the initiation of the A3, we’ve had 1 problem with supplies.

**Application:** Inpatient discharge checklist and creating Patient's Daily Binder with all the pertinent information for daily care for infants on PD can be readily incorporated into clinical practice to improve care.

**Conclusion:** By utilizing the “A3” method, we identified the types of problems associated with discharging infants on PD as well as solutions to prevent future similar problems. Further monitoring of this process will help us to maintain these improvements and serve as a guide for other institutions implementing PD for infants.

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### Comparison of Reticulocyte Hemoglobin Equivalent with Traditional Markers of Iron and Erythropoiesis in Pediatric Dialysis

**Background and Objectives:** Anemia is a major complication for patients with chronic kidney disease (CKD) on dialysis. Treatment with recombinant human erythropoietin (rHuEPO) is only effective if iron is available for erythropoiesis, but unnecessary iron supplementation can result in iron overload. Reticulocyte hemoglobin equivalent (Ret-He) may be more reliable than ferritin and transferrin for assessing iron status in adults with CKD; however, Ret-He data are lacking in the pediatric dialysis population. Our objective was to investigate the relationship between Ret-He and traditional markers of iron and erythropoiesis to determine if Ret-He might be useful in the evaluation of iron status in this population.

**Design, Setting, Participants and Measurements:** This was a national retrospective cohort study including 45 children with end-stage kidney disease on chronic dialysis in New Zealand between 2007 and 2013. The final dataset contained 606 observations of Ret-He data paired with demographic information, anemia indices, and markers of iron status.

- **Results:** We found a modest relationship between Ret-He and transferrin saturation (TfSat) (r=0.34, p<0.001) and poor correlation between Ret-He and serum ferritin (r=0.09, p=0.04). In relation to anemia, we found a weak negative correlation between serum ferritin and hemoglobin (r= -0.14, p=0.002), a weak positive correlation between Tsat and hemoglobin (r=0.12, p=0.007) and a modest positive correlation between Ret-He and hemoglobin (r=0.22, p=0.001). Ret-He and HbEPO weekly dose were modestly negatively correlated (r= -0.26, p<0.001). The diagnostic performance of Ret-He to detect absolute iron deficiency (cutoff value 9.1 g/L, sensitivity 75% and specificity 73%, AUC 0.718) was moderate.

- **Conclusions:** Ret-He was superior to ferritin and Tsat, but the diagnostic performance can be considered only moderate. The correlations with Hb, HbEPO dose, and Tsat support prospectively testing the hypothesis that Ret-He can distinguish between iron deficiency and suboptimal HbEPO dosing as competing causes for anemia in the pediatric dialysis population. Ferritin is unhelpful as a biomarker of iron deficiency in this setting.

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### An Unusual Complication of Peritoneal Dialysis Catheter: Foreign Body per Rectum

**Introduction:** Intestinal perforation due to peritoneal dialysis (PD) catheter insertion is rare and can lead to significant morbidity and mortality. We present a case of a pediatric patient with peritoneal dialysis catheter perforating colon and presenting as a foreign body protruding from anus with no symptoms and signs of perforation.

**Patient Presentation:** A 13-y.o. Caucasian male with history of end-stage renal disease due to obstructive uropathy presented with 1 day history of rectal bleeding and acute peritonitis. There was no history of previous peritonitis or abdominal surgery. Physical examination revealed a peritoneal dialysis catheter in the rectum with no evidence of peritonitis. The catheter was removed and the patient was discharged with no further events.

**Conclusion:** This case highlights the importance of recognizing and managing foreign body protrusion from the anus in pediatric patients on PD, as this can be a common presentation in the absence of symptoms or signs of peritonitis.

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### Impact of Fill Volume on Ultrafiltration with Icodextrin in Children on CCPD

**Background:** Icodextrin is a solution of glucose polymers developed to provide sustained ultrafiltration (UF) over an extended dwell, thus avoiding the need for hypertonic glucose solutions.

**Aim:** To determine if there is a relationship between the day volume (mL/m2BSA) of Icodextrin and the ability to achieve UF.

**Methods:** REB approval was obtained to retrospectively screen the charts of all children on chronic PD between January 2000 and July 2014. Patients using an Icodextrin dwell for whom data were available were enrolled. Data were collected using the electronic chart and the Home Choice Pro care card and included demographics, day dwell volume and time, membrane characteristics (PET data), daytime UF achieved, and reason for cessation. Data were collected at 3 time points after starting Icodextrin. Average UF over 6-7 consecutive days was recorded.

**Results:** During the study period 104 children received chronic PD. 50 patients (age range 7 mos to 17.8 yrs; mean 12.8 yrs) had an Icodextrin day dwell at any time and had minimum 6 consecutive days of UF data recorded. Reasons for terminating Icodextrin use were available for 37 patients: 19 were transferred to adult dialysis centers on Icodextrin, and 1 died. Patients with fill volume below this threshold (mean 44% of patients with fill volume >550 mL/m2BSA achieved more UF (mean 107±75 mL/m2BSA/day; p=0.0004). 88% of patients with fill volume >550 mL/m2BSA achieved UF compared with 44% of patients with fill volume below this threshold (p=0.001).

**Conclusions:** Our observations reveal that the larger the fill volume the better the chance of ultrafiltration, and suggest using a minimum Icodextrin day dwell volume of 550 mL/m2BSA to facilitate ultrafiltration in most children on PD.

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Prevalence and Risk Factors for Complicated Course and Long-Term Sequels in Children with Acute Diarrhea Positive Hemolytic Uremic Syndrome, Hospitalized at Children’s Mercy Hospital

Background: Hemolytic uremic syndrome (HUS) is the most common cause of acute renal failure in childhood. The primary goal of the study was to identify risk factors for more severe acute disease (need for dialysis). The secondary aim was to determine the risk factors for development of chronic kidney disease (CKD).

Method: 59 pediatric patients (<2 yrs old; males: 59%) treated for HUS in our hospital between 2/2002 and 1/2011 were included via IC9-CM code. Variables used to identify differences between the dialyzed and non-dialyzed groups were age, gender, admission weight, hemoglobin (HGB), serum creatinine (first and mean values), LDH, and urine output (UOP).

Results: 32 patients required dialysis (9 male); 75% of them peritoneal (PD). Dialysis was more likely initiated if a patient was a female (8.4 vs. 0.206) or anuric (p<0.001). Other results will be presented. CNS complications (5 patients) developed only among dialyzed patients (p=0.032), and were more common if the patient received hemodialysis (HD) compared with PD (p=0.003). CKD developed more often in children who received HD (p=0.043). Patients who developed CNS complications were more likely to have CKD (p=0.029).

Conclusions: Pediatric patients with HUS who are likely to require dialysis can be identified by female gender, lower UOP higher creatinine level as well as higher HGB, and they are at higher risk to develop CNS complications. The close association between need for dialysis and CNS complications may indicate a more severe illness, reflected also in the higher chance to develop CKD. Further studies are required to see if dialysis modalities have a role to protect against the development of severe complications.

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Risk for Peritonitis Among Patients Enrolled in the SCOPE Collaborative

Background: Standardized Care to Improve Outcomes in Pediatric ESRD (SCOPE) Collaborative is a national quality-improvement initiative with a mission to reduce peritoneal dialysis (PD)-associated infections among pediatric PD patients. Quality improvement methods were employed to increase implementation of the following best practice “bundles”: insertion of the PD catheter, PD training, and follow-up catheter care. Objective: To describe risk factors for peritonitis, including compliance with care bundles, among patients enrolled in the first 24 mos of SCOPE.

Design/Methods: Data pertaining to patient and PD characteristics, compliance with the bundles, and peritonitis were collected between 10/2011 and 9/2013 from the SCOPE registry. Peritonitis was defined as any infection that was treated as peritonitis (relapsing peritonitis excluded). Chi-square analysis was used to assess the relationships between variables.

Results: Of 576 children enrolled, 242 peritonitis episodes occurred among 158 individuals (25% male, median 7.5 yr, IQ range 0-14) over 6,198 patient mos in 29 centers. The aggregate annualized peritonitis rate was 0.47 per patient-yr. Rates were highest among children <2 yr of age (0.8 per patient-yr), followed by the 18-24 yr age group (0.68 per patient-yr). Black race (28% vs. 17%, p=0.002), G-tree (49% vs 32%, p=0.001), recency (52% vs 40%, p=0.017), upward orientation of the catheter (7% vs 2%, p=0.001), plastic adapter (45% vs 32%, p=0.004), and touch contamination (37% vs 16%, p<0.001) were more common in children with peritonitis. Overall compliance with the insertion bundle was lower in patients with peritonitis compared to those without (38% vs 57%, p=0.04), as was compliance with specific insertion bundle elements of sterile dressing change (p=0.004) and withholding dialysis for 14 days postinsertion (p=0.01). Lower compliance with the training bundle (53% vs. 71%, p=0.008) and the specific element of the home visit was also associated with peritonitis (p=0.005). Those with peritonitis had lower compliance with the follow-up bundle (54% vs. 64%, p=0.001), and with specific elements of site-site scoring (p=0.03), performing a concept test (p=0.001), and review of hand washing, exit care, and aseptic technique (all p<0.001).

Conclusions: PD-associated peritonitis most commonly occurs in children younger than 2 yr. At the patient level, lower compliance with best practices for PD catheter care is associated with an increased risk for peritonitis. Evidence-based prevention strategies have the potential to reduce the frequency of this significant complication of therapy.

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IV Iron and Strengthening an Anemia Protocol: A Single Pediatric Center’s Experience

Background: Oral iron (maintenance or repletion) supplements are often not effective due to poor bioavailability, poor compliance (GI side effects), and the need to time the medication away from meals. Administration of IV iron to a peritoneal dialysis (PD) patient means more patient visits to the clinic (patients frequently traveling 60-300 miles) and cannulation of veins that may be very small or needed for future hemodialysis (HD) access. Despite the simplicity of the concept, development and implementation (to center around IV iron administration) was delayed in our small, freestanding, pediatric dialysis unit.

Approach: Prior to a newly created IV iron-based protocol, responses to hemoglobin began with adjustments to ESA dosing. Providers were not utilizing an old protocol — it was presumed to be inadequate. The new IV iron-based protocol utilizes flowcharts as decision-making tools based on iron studies and hemoglobin. There are separate flowcharts for the modality (PD or HD) that guide iron administration. Each modality’s flowchart leads to one single, common ESA dosing adjustment when needed. The new protocol also guides decisions to hemoglobin outside the range 10.3-11.3 mg/dl (previous 10.0-12 mg/dl).

Following 4 mos of use of this new protocol, improvement was most notable for reducing above-target hemoglobin. In review of the protocol’s use, it was found the modality-specific flowchart was not consistently applied prior to utilizing the ESA flowchart. The provider team was re-educated, emphasizing the iron component on the modality-specific flowchart.

Results:

Hemoglobin: Jan-April (strictly following earlier May-Aug (IV iron-focused protocol))

| Protocol | Below goal | Above goal |
|----------|------------|------------|
| IV iron  | 54%        | 27%        |
| Control  | 55%        | 8%         |

Discussion: Through an IV iron-refocused protocol, our anemia data has begun to improve. The flowcharts provide guided decision-making and emphasize iron dosing. The flowcharts describe the need for repletion of iron versus maintenance iron dosing. It is imperative to utilize iron dosing via the modality-specific flowchart prior to adjusting ESA.

Conclusion: Despite the pediatric challenges, a monthly IV iron-focused protocol allows better iron and hemoglobin control in children.

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PDI FEBRUARY 2015 – VOL. 35, SUPPL. 1    ABSTRACTS OF THE 35TH ANNUAL DIALYSIS CONFERENCE
Effects of Sleep Disturbances on Cardiovascular Health and Quality of Life in Pediatric Dialysis Patients

Introduction: Sleep disturbances are common in patients undergoing maintenance dialysis manifesting as problems with sleep quality, sleep quantity, or daytime fatigue. Prior studies demonstrate that sleep disturbances such as sleep-disordered breathing, sleep apnea, and restless leg syndrome frequently occur in the adult dialysis population and are independent risk factors for cardiovascular (CVS) disease, morbidity, and mortality. The primary objective of this study is to determine whether improved sleep in children receiving dialysis will improve cardiovascular health and quality of life.

Specific Aim: To assess whether pediatric dialysis patients with sleep disturbances receiving sleep intervention have improved outcomes compared to those without.

To assess whether improving sleep improves cardiovascular outcomes.

Methods: Study Design: Single-center randomized controlled trial. All patients age 3-21 yrs who have been on dialysis for longer than 1 mo considered for inclusion. Patients less than 3 yrs of age were not considered as they are less likely to sleep continuously through the night. Hospitalized patients receiving dialysis for acute kidney injury, fluid overload, palliative care, or metabolic reasons were also not considered.

Statistical Analysis: CSV outcome assessed with casual blood pressure (BP) measurements, ambulatory blood pressure, and echocardiography. BP measured as both a continuous and binary variables.

Quality of life measured by self-reported survey considered a binary variable (improvement in quality of life or no improvement).

Hypothesis tests will be 2-sided with alpha = 0.05 and p-values reported.

Preclinical and Clinical Experience: 1326 patients (61.9%) had difficulty with sleep. Interim findings revealed no statistical significance in categorical hypertension or left ventricular hypertrophy in patients with sleep disturbances compared with those without. Dialysis patients with sleep disturbances had adequate nocturnal diaphoresis in the first 24 hrs of ABPM (p=0.017), as well as during the 2nd night (p=0.037), compared to those without sleep disturbances.

Conclusions: Sleep disturbances are common in pediatric dialysis patients. Preliminary data shows 2 consecutive days of inadequate nocturnal diaphoresis which may be a precursor to poor cardiovascular health.

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Providing Adequate Calcium Supplementation in Infants on Dialysis to Prevent Hypocalcemic Seizures

Introduction: Complications of peritoneal dialysis (PD) such as ultrafiltration failure (UF) and fluid leaks may result in reduced dialysis efficiency and technique failure, and may be challenging to diagnose. Peritoneal scintigraphy (PS) is one radiological technique which may aid in diagnosis of fluid leaks and causes of UF failure. We sought to analyze the value of PS in the diagnosis of PD complications, and its influence on subsequent patient management.

Methods: REB approval was obtained to review the charts of patients on chronic PD who underwent PS over the last 20 yrs to assess the contribution to diagnosis, and the impact of the information obtained on patient care. PS was performed using Tc99m-Sulfur Colloid added to a standard bag of PD fluid. Dynamic and sequential static images were obtained up to 24 hrs.

Results: From 1998 to 2013, 10 PS studies were obtained in 9 patients on chronic PD. Patients ranged in age from 5 mos to 17.75 yrs, and had been on PD for 2 wks to 2.75 yrs at the time of imaging. Indications for PS included UF failure (2), chest mass (1), scrotal/labial swelling (4), pleural effusion (1), PD catheter non-function (1), and elevated hemidiaphragm (1). PS was useful to confirm a PD-related fluid leak in the pelvis/abdominal wall (1), and a diaphragmatic hernia (1). It was helpful to exclude PD fluid leaks as a cause of swelling (3) and as a cause of UF failure (2), and excluded loculation of fluid as a cause for catheter malfunction (1). PS was negative in 1 patient with clinical evidence of a scrotal fluid leak postbilateral inguinal hernia repair. In the patient undergoing 2 studies, the initial study did show a leak in retroperitoneal. 4 patients were switched to hemodialysis, 1 temporarily.

Conclusion: PS is simple to perform, has low radiation, and allows for dynamic whole-abdominal imaging in multiple portions and delayed imaging up to 24 hrs. It is useful for diagnosing or ruling out PD-related fluid leaks and in eliminating fluid leaks as a cause of UF failure, and may be helpful in the diagnosis of catheter malfunction. It can be considered as a first-line imaging tool for diagnosis of suspected PD-related fluid leaks.

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Peritoneal Scintigraphy in Children on Chronic PD

Introduction: Studies have suggested that free calcium concentration may be increased in pediatric PD patients on low calcium dialysate. If this is confirmed, these patients may be at risk of hypocalcemic seizures. We have recently observed an incidence of hypocalcemic seizures among our infant dialysis patients who were less than one year of age.

Methods: We reviewed all cases where infant dialysis patients developed seizures over a short period of time, a quality improvement project was started to look into adequate calcium supplementation for our infant dialysis patients who were less than one year of age.

Results: Upon review of these infants, the mean total calcium was 6.9 and mean ionized calcium was 0.82. All of the patients were receiving their DRI of calcium at the time of their seizure, except one preterm infant who did not meet calcium DRI for his gestational age. Because these presentations occurred over a short period of time, a quality improvement project was started to take a closer look at calcium levels and supplementation for our infant dialysis patients who were less than one year of age.

Conclusions: The primary goal was to ensure that our patients received appropriate calcium supplementation to maintain their calcium levels to prevent hypocalcemic seizures.

Application in Clinical Practice: Currently, all of our patients, as part of their monthly nutrition evaluation, have their laboratory studies and calcium supplementation reviewed closely. Their supplements are then adjusted to reflect any changes that have been noted. Because of this application, we have not had any infants experience hypocalcemic seizures since January 2013.

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