Acute Care Pediatric Nephrology
WHAT CAN I DO?

By Nadia McLean, Shina Menon, and Stuart L. Goldstein

The call was one received ever so often, for this fledgling nephrology service on the small island: A newborn with no urine output and a startlingly high blood urea nitrogen and creatinine. He had become edematous and would soon need a ventilator. There was no antenatal ultrasound, as is the norm in these rural parts. A few calls are made to the capital: their wards are full. "It's you and me, baby" is the thought that runs through the young nephrologist's head as she makes her way to the hospital neonatal ICU. What are her options? She recalls similar discussions during her fellowship training abroad, but it wasn't the dilemma of what could be offered; it was the ethical considerations of futility in starting kidney replacement therapy. In a well-established nephrology program, one could have these elevated and cerebral discussions. What would be the quality of life of this baby should we start dialysis? What modality would be best for his antenatally diagnosed condition? In her small rural hospital where she is the nephrology service, without a cadre of dietitians, nurses, neonatologists, and patient care coordinators at her disposal, the question is "What can I do?"

Nourse et al. in the recently published International Society for Peritoneal Dialysis (ISPD) guidelines for peritoneal dialysis in acute kidney injury noted that acute peritoneal dialysis has a similar track record to other kidney replacement therapies. Peritoneal dialysis remains cost and resource effective, thus remaining the preferred modality for lower middle income countries (LMIC) (1). According to the World Health Organization, the burden of end stage kidney disease (ESKD) in LMIC may approach that of high-income countries (HIC), and low socioeconomic status may be associated with higher rates of ESKD. Despite the need, most patients receiving kidney replacement therapy live in HIC (2). In fact, as recently as 2020, Qarni et al. noted the inequity in access to kidney replacement therapy, particularly as it related to acute and chronic peritoneal dialysis (3).

In addition to easily accessible, low cost, and less complex methods of kidney replacement therapy, collaboration and access to information often form the backbone of delivery of care to these often complex and critically ill patients. Junior faculty returning to LMIC do not often have the benefit of in-house consultation with a multidisciplinary team or with expert senior faculty members. However, although the current pandemic has separated us physically, it has had the fortunate side effect of bridging the information gap that previously existed. Specialists in LMIC are now able to access up-to-date information and international expertise and to commiserate on complex cases once they have a wifi connection. Opportunities also exist for expanded, cross-national collaboration and education that can serve to mutually benefit nephrologists who practice in variably resourced settings and in different parts of the world.

In the future, through ongoing collaboration, education, and advocacy, our young nephrologist may not have to wonder "What can I do?" but should be able to ask, "Who can I call for help?" ■

Nadia McLean MBBS, DM, is a pediatric nephrologist at the Cornwall Regional Hospital in Montego Bay, St. James Parish, Jamaica, W.I. Shina Menon, MBBS, is a pediatric nephrologist at Seattle Children's Hospital and Assistant Professor of Pediatrics at the University of Washington, Seattle. Stuart Goldstein, MD, FASN, is a pediatric nephrologist and Director of the Center for Acute Care Nephrology at Cincinnati Children's Medical Center and a Professor of Pediatrics at the University of Cincinnati College of Medicine, OH.

Drs. McLean, Menon, and Goldstein report no conflicts of interest.

References

1. Nourse P, et al. ISPD guidelines for peritoneal dialysis in acute kidney injury: 2020 update (pediatrics). *Perit Dial Intl* 41:139–157. doi:10.1177/0896860820982120
2. White SL, et al. How can we achieve global equity in provision of renal replacement therapy? *Bulletin of the World Health Organization* 2008; 86:229–237.
3. Qarni B. (2020-Supplement, January). Kidney care in low- and middle-income countries. *Clin Nephrol* 93:21–30. doi:10.5414/CNP92S104

Neonatal Nephrology
A Growing Problem in Need of an Innovative Solution

By Michelle Starr, Tahagod Mohamed, Katherine Twombley, and Keia Sanderson

Kidney disease in premature infants and critically ill neonates is a growing problem. One in 10 children is born prematurely each year (1). In these neonates, improvements in neonatal intensive care have increased survival and shifted focus to long-term outcomes. Kidney-related outcomes are increasingly recognized in this population (2). Children born prematurely have a 3-fold increased risk of chronic kidney disease (CKD) and a 1.5-fold increased risk of end-stage kidney disease over the life course compared to children born full term (2, 3). This clinical problem will continue to grow as more survive prematurity into adulthood.

Neonates admitted to the neonatal intensive care unit (NICU) may be inherently at increased risk of CKD (4, 5). In those born prematurely, this risk is thought to result from disrupted nephrogenesis, resulting in a lower nephron number. In addition, acute kidney injury (AKI) occurs in up to 30% of high-risk neonates admitted to the NICU from both intrinsic factors (including low nephron number, low glomerular filtration rate [GFR], and tubular immaturity) and extrinsic factors (such as increased insensible losses and nephrotoxic medications) (6, 7). Infants who survive NICU admission and had an episode of AKI are at increased risk for repeated episodes of AKI as well as CKD (8). All patients, including infants, surviving an episode of AKI should have long-term monitoring for CKD. Unfortunately, the diagnosis of AKI remains underrecognized, made in only 10%–30% of neonates (9). The reasons for under-diagnosis are complicated but likely related to underrecognized, subtle changes in serum creatinine that reflect significant alterations in GFR and a lack of awareness of neonatal AKI definitions (10). Without clinical recognition of the impact of preterm birth and AKI on CKD risk, many neonates are not identified for long-term kidney follow-up, reducing providers' ability to identify CKD early. Children are not routinely screened for kidney disease, and those who develop CKD often do not experience symptoms until the kidney damage is severe and irreversible. Healthcare costs increase fourfold with a late-stage CKD diagnosis (11, 12).

One potential solution to this gap in AKI diagnoses and follow-up after preterm birth and AKI is increasing nephrology integration into the NICU. Studies show programs that integrate early pediatric nephrologist consultation into the NICU improve AKI diagnosis (13). There are multiple models that have been implemented successfully, including nephrology consults on all NICU patients with AKI identified by electronic medical record review (Riley Children's Hospital). Some centers lead weekly NICU nephrology rounds in which all neonates with AKI are evaluated by a nephrologist (Nationwide Children's Hospital). Other centers have developed local guidelines for neonatologists to support AKI recognition and consultation with pediatric nephrology (Medical University of South Carolina and University of North Carolina).

No matter the model, we strongly believe that the integration of pediatric nephrology providers into NICUs improves the recognition and management of AKI and increases follow-up of patients at high risk for future CKD. The importance of neonatal nephrology integration is especially valuable in the NICU where the diagnosis of AKI is challenging. A Neonatal Nephrology Program emphasizes early referral to a nephrology clinic and facilitates discussion of kidney health monitoring, early identification of CKD, and risk reduction. Early identification of pediatric patients with CKD is essential to slow the progression of kidney disease, as it allows for the initiation of treatment to improve kidney function into adulthood. ■

Michelle Starr, MD, MPH, is Assistant Professor, Division of Pediatric Nephrology, Department of Pediatrics, Indiana University School of Medicine and Riley Children's Hospital, Indianapolis, IN. Tahagod Mohamed, MD, is Assistant Professor, Division of Nephrology and Hypertension, Nationwide Children's Hospital, The Ohio State University College of Medicine, Columbus, OH. Katherine Twombley, MD, FAAP, FAST, is Professor of Pediatrics, Division of Pediatric Nephrology, Medical University of South Carolina, Charleston, SC. Keia Sanderson, MD, MSCR, is Assistant Professor of Medicine and Pediatrics, Division of Nephrology and Hypertension, University of North Carolina, Chapel Hill, NC.

The authors report no disclosures associated with the article.

References

1. Horbar JD, et al. Mortality and neonatal morbidity among infants 501 to 1500 grams from 2000 to 2009. *Pediatrics* 2012; 129:1019–1026. doi: 10.1542/peds.2011-3028
2. Eriksson JG, et al. Prenatal growth and CKD in older adults: Longitudinal findings from the Helsinki Birth Cohort Study, 1924–1944. *Am J Kidney Dis* 2018; 71:20–26. doi: 10.1053/j.ajkd.2017.06.030
3. Vikse BE, et al. Low birth weight increases risk for end-stage renal disease. *J Am Soc Nephrol* 2008; 19:151–157. doi: 10.1681/ASN.2007020252
4. Carmody JB, Charlton JR. Short-term gestation, long-term risk: Prematurity and chronic kidney disease. *Pediatrics* 2013; 131:1168–1179. doi: 10.1542/peds.2013-0009
5. Sanderson KR, et al. Albuminuria, hypertension, and reduced kidney volumes in adolescents born extremely premature. *Front Pediatr* 2020; 8:230. doi: 10.3389/fped.2020.00230
6. Jetton JG, et al. Incidence and outcomes of neonatal acute kidney injury (AWAKEN): A multicentre, multinational, observational cohort study. *Lancet Child Adolesc Health* 2017; 1:184–194. doi: 10.1016/S2352-4642(17)30069-X
7. Selewski DT, et al. Neonatal acute kidney injury. *Pediatrics* 2015; 136:e463–e473. doi: 10.1542/peds.2014-3819
8. Mammen C, et al. Long-term risk of CKD in children surviving episodes of acute kidney injury in the intensive care unit: A prospective cohort study. *Am J Kidney Dis* 2012; 59:523–530. doi: 10.1053/j.ajkd.2011.10.048
9. Carmody JB, et al. Recognition and reporting of AKI in very low birth weight infants. *Clin J Am Soc Nephrol* 2014; 9:2036–2043. doi: 10.2215/CJN.05190514
10. Kent AL, et al. Neonatal acute kidney injury: A survey of neonatologists' and nephrologists' perceptions and practice management. *Am J Perinatol* 2018; 35:1–9. doi: 10.1055/s-0037-1604260
11. Mitsnefes MM. Cardiovascular disease in children with chronic kidney disease. *J Am Soc Nephrol* 2012; 23:578–585. doi: 10.1681/ASN.2011111115
12. Elshahat S, et al. The impact of chronic kidney disease on developed countries from a health economics perspective: A systematic scoping review. *PLoS One* 2020; 15:e0230512. doi: 10.1371/journal.pone.0230512
13. Starr MC, et al. Improving the recognition and reporting of acute kidney injury in the Neonatal Intensive Care Unit. *J Perinatol* 2020; 40:1301–1307. doi: 10.1038/s41372-020-0725-y

Pediatric Dialysis Care: A Brief Update

By Shweta Shah and Sarah J. Swartz

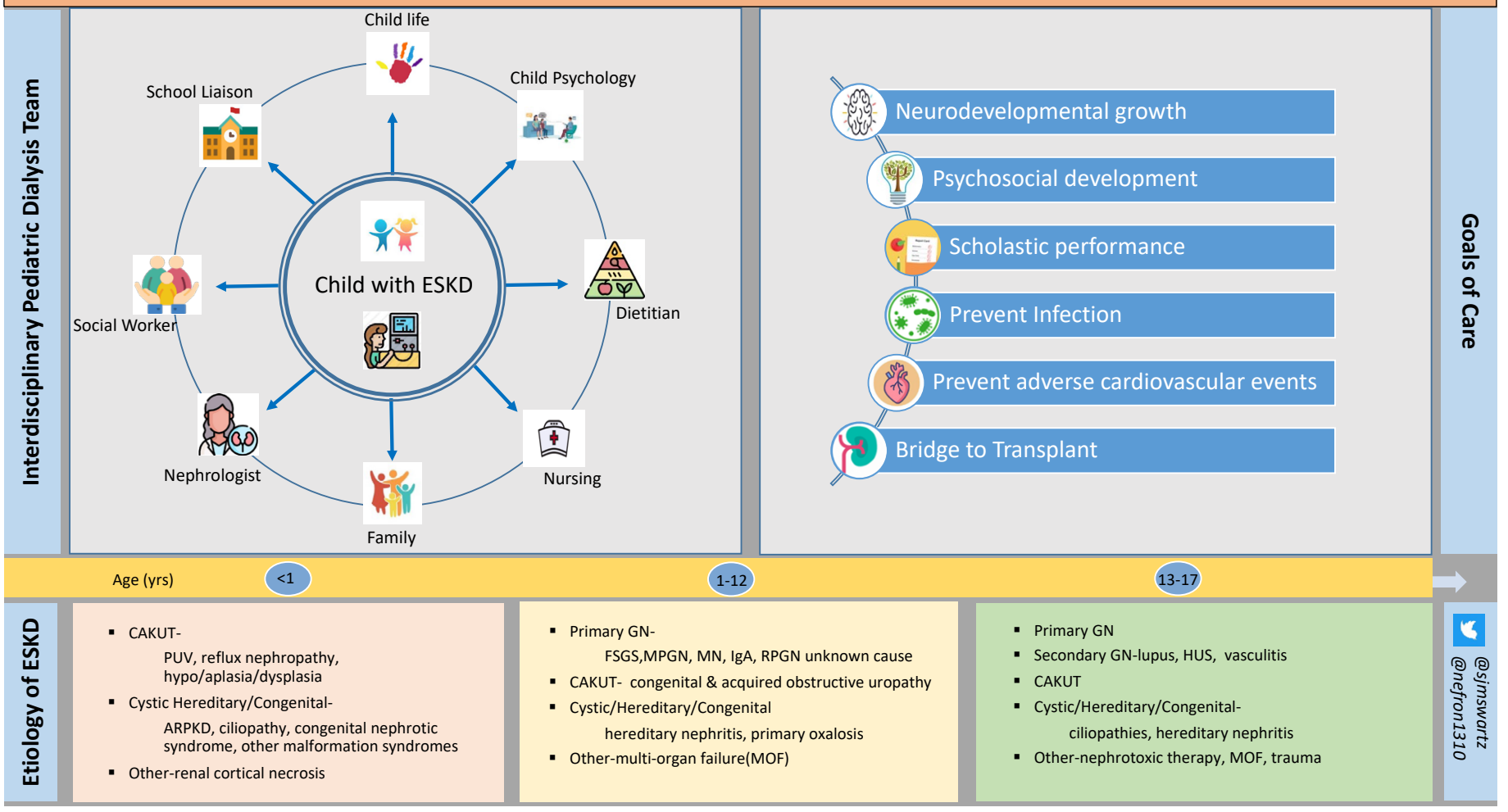
Although the number of children with end-stage kidney disease (ESKD) is small compared to adults, their management can pose a unique challenge due to variability in size and their complex medical, growth, and maturational needs, as well as caregiver involvement. The adjusted incidence of ESKD in children has remained relatively unchanged from 2014 to 2018, ~11.5 per million population, whereas prevalence has increased, with close to 71% of the pediatric ESKD population receiving kidney transplant (1). Racial disparities are noted in modality of treatment, with White children twice as likely to receive a kidney transplant as Black children, and the latter more likely to receive hemodialysis (HD) over peritoneal dialysis (PD). Hispanic-Latino children are also less likely to receive kidney transplant and initiate HD more often than PD compared to non-Hispanic children.

Congenital abnormalities of the kidney and urinary tract (CAKUT) remain the primary etiology for kidney failure in infants and young children, whereas etiology is more varied in the adolescent age group, with a higher prevalence of glomerulonephritis and tubulointerstitial diseases. In comparison, diabetes, neoplasms and tumors, and hypertensive/large vessel disease are relatively uncommon causes of incident ESKD in children (1). Adjusted mortality has declined in recent years, with the primary cause of death being cardiovascular disease (25%) followed by infection (13.3%). Hard cardiovascular endpoints (such as stroke, myocardial infarction, and death) have low incidence in the pediatric ESKD population; therefore, surrogate markers like left-ventricular hypertrophy, pulse-wave velocity, and carotid-intimal thickness are often used in outcome-based research studies (2).

The prevention of infection is imperative for children on dialysis. Infections are not only a leading cause of mortality for children with ESKD but also lead to increased morbidity, posing an important risk factor for PD failure or the need for HD access replacement with potential loss of a vascular access site.

Focused on increasing implementation of standardized best care practices initially for pediatric PD patients and later pediatric HD patients, the Standardizing Care to Improve Outcomes in Pediatric End Stage Renal Disease (SCOPE)

Figure 1. Pediatric Dialysis Care: A Brief Update



PUV, posterior urethral valve; ARPKD, autosomal-recessive polycystic kidney disease; GN, glomerulonephritis; FSGS, focal segmental glomerulosclerosis; MPGN, membrano proliferative GN; MN, membranous nephropathy; IgA, immunoglobulin A; RPGN, rapidly progressive GN; HUS, hemolytic uremic syndrome.

Continued on page 22