Long-term Survival in a Patient with Bilateral Renal Agenesis

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Abstract

Bilateral renal agenesis is a rare condition where live births occur but death ensues shortly after, usually from pulmonary hypoplasia. A fetus with bilateral renal agenesis can avoid pulmonary hypoplasia in situations of a monoamniotic monochorionic (MoMo) twin. Herein we describe a MoMo infant surviving past 3 years. Bilateral renal agenesis is often part of a syndrome. Our patient had VATER (vertebral, anal, tracheo-esophageal and renal anomalies) syndrome, including vertebral abnormalities and imperforate anus. Surviving cases of bilateral renal agenesis are exceptionally rare. A search showed seven cases of infants with bilateral renal agenesis with one surviving beyond 2 months of age. We provide clinical course details of a MoMo infant surviving over 3 years, currently on the transplant wait list. During her first year, in addition to three episodes of peritonitis, she experienced sequelae common to infants with end stage renal disease. One exception was the extent of secondary hyperparathyroidism, which improved only after cinacalcet was begun. Despite this, her general development has been excellent.

Keywords
bilateral renal agenesis; anephric; peritoneal dialysis; neonatal end stage renal disease

Abbreviations
VATER: vertebral, anal, tracheo-esophageal and renal anomalies; DOL: day of life;
MoMo: monoamniotic monochorionic

Introduction

Congenital renal anomalies are the most common cause of pediatric end stage renal disease, accounting for 39% of pediatric transplants in 2010 [1]. Bilateral renal agenesis occurs at a rate of 1 in 4,000 births and is incompatible with extended life. Lack of amniotic fluid results in Potter's sequence, including bowed legs, club feet, and widened epicanthic folds with a flat nose and low-set ears as well as other organ malformations like pulmonary hypoplasia, the primary cause of death [2].

Although live births occur, infants with bilateral renal agenesis rarely live more than a day which is why the condition has been described as perinatal lethal renal disease [3]. One case report describes an infant whose mother underwent serial amnio transfusions surviving to at least 9 months post-gestational age [4]. Under the additional condition of a monoamniotic monochorionic (MoMo) twin with normal kidneys, viable lungs may form [4-9]. In MoMo twins, one fetus with kidneys provides the critical amniotic fluid for both. Although the fetus without kidneys can survive up to the time of delivery and...
avoid Potter’s sequence anomalies, we found no cases of bilateral renal agenesis in MoMo neonates surviving beyond 2 months of age (see Table) [9]. We describe a bilateral renal agenesis MoMo infant who has thrived because of developments in peritoneal dialysis.

**Case Presentation**

A 31-year-old, gravida 5, para 3 woman had a MoMo twin gestation. Prenatal ultrasound at 30 weeks showed bilateral renal agenesis with hemivertebrae in twin A. Omphalocele, bladder extrophy, vertebral anomalies, and congenital heart disease were evident in twin B. The twins were delivered at 34.2 weeks gestation. Twin A had a 2-vessel umbilical cord, imperforate anus and ambiguous genitalia. Twin B had ambiguous genitalia and patent ductus arteriosus. Both twins were chromosome 46 XX with normal chromosomal microarray (Combimatrix, 170k). Twin B expired on day of life 95 from respiratory failure related to pulmonary hypertension.

After delivery, Twin A easily transitioned to room air without signs of pulmonary hypoplasia. On day of life (DOL) 3, surgeons placed a colostomy in the left lower quadrant and a Tenckhoff peritoneal dialysis catheter on the right. On DOL 13 she started low volume continuous peritoneal dialysis. Our patient experienced typical comorbidities of renal disease. In her first 12 months she had three episodes of peritonitis (*Enterococcus faecalis, Enterobacter aerogenes, and Enteroccocusfaecalis* on DOL 151, 190, and 271 respectively). This exceeds typical culture-positive peritonitis in the first 12 months of life according to NAPRTCS (The North American Pediatric Renal Trials and Collaborative Studies), where the 2011 annualized rate is 0.79 infections per year for 0- to 1-year-olds [1]. We treated intermittent hypertension with isradipine and daily amlodipine was begun on DOL 225. Perinatal echocardiogram was unexceptional. Metabolic acidosis was treated with supplemental bicarbonate starting DOL 68. The patient required epoetin alpha beginning DOL 4. Her secondary hyperparathyroidism resisted traditional therapy with calcitriol. Secondary hyperparathyroidism improved with cinacalcet, which was started on DOL 248 with serum parathyroid hormone (iPTH) of 1834 pg/ml. Our patient's electrolyte abnormalities included hyponatremia, hyperkalemia, and metabolic acidosis. We supplemented sodium chloride and bicarbonate as necessary. Hyperkalemia resisted low potassium formula and was treated by chelating her formula with sodium polystyrene sulfonate.

Nutritionally she reached full enteral feeds on DOL 60, having been fed with donor breast milk, then Similac 60/40 and Good start Gentle (as serum potassium permitted). A gastrostomy tube was placed on DOL 101.

Birth parameters at birth were weight 1.95 kg (10-50th percentile), length 41 cm (below 3rd percentile), and head circumference 30 cm (3rd-10th percentile) according to the Fenton growth chart [9]. With appropriate nutrition, her weight reached 8.8 kg (10-25th percentile) at 12 months of age. At that time her length was 65 cm and head circumference 43 cm, both below the 2nd percentile (according to World Health Organization growth chart) [11].

Development has been promising. Motor skills were assessed by Peabody Developmental Motor Scales [12]. At 7 months (6 months corrected age), her grasp was at the age equivalent of 5 months while visual motor integration was at 7 months, and gross motor function was at a 5-month level. As for social
social development, she performed many skills at the 6-9 month level, but language expression and comprehension were at a 3-6 month age level. She was reassessed at 13 months (12 months corrected age), and both grasp skills and visual motor integration were at 10 months. Gross motor function, reflexes and stationary skills were at the level of 9 months of age, locomotion at the 6-month level, object manipulation at 12 months, and speech at 9 months. Our patient demonstrated age-appropriate social interaction.

After 1 year of age, our patient developed a seizure disorder at 23 months of age controlled with levetiracetam. She was treated by orthopedics for osteopenia with ankle/foot orthosis and began ambulating with the help of a walker at 45 months old. She underwent ileal conduit creation in preparation for renal transplant and has had 4 cases of peritonitis over the past 30 months since initial hospital discharge.

Discussion

Historically, bilateral renal agenesis is fatal in the perinatal period. In the rare case of MoMo twins, where production of urine by one twin protects the other from the effects of inadequate amniotic fluid (especially pulmonary hypoplasia), neonates have a chance for long-term survival. Frequently bilateral renal agenesis patients in the setting of MoMo twins still exhibit features of Potter’s sequence, and, sometimes, extra renal syndromic abnormalities such as VATER. The cause of VATER syndrome is believed to be multifactorial, including environmental factorssuch as maternal diabetes and genetic factors as familial clustering is noted [13].

Our literature review (Table) showedincremental improvement in bilateral renal agenesis survival. In 2014 a patient survived beyond 9 months, this infant did not have VATER syndrome and their mother underwent serial amniotic fluid transfusions (Table 1). The infant described in our case is the first MoMo bilateral renal agenesis to survive, currently past 3 years and listed for transplant. Many cases of bilateral renal agenesis in MoMo twins demonstrate the following pattern: normal lung tissue, lack of Potter’s sequence, and extra renal comorbidities.

As an infant with VATER association findings, our patient’s history fits with these reports of MoMo twins. However, she has survived on peritoneal dialysis. Similar to other infants with end stage renal disease, our patient has demonstrated growth and developmental delay, anemia, hypertension, and peritonitis. During her first year of life, persistent hospitalization and the presence of a gastrostomy tube are two risk factors that could account for her increased rate of infection [14]. Her course also deviated from the typical end-stage pattern with respect to difficulty of control of her secondary hyperparathyroidism. Recommendations for infants and children on peritoneal dialysis suggest serum iPTH goals of 1.7 to 3 times the upper limits of normal, or 100-200 pg/ml [14]. Despite aggressive therapy with calcitriol and cinacalcet, her serum iPTH exceeded has been difficult to control and she has evidence of metabolic bone disease. Dietary factors, bilateral renal agenesis, or syndromic extra renal manifestations could contribute to the poor control of secondary hyperparathyroidism. Because the patient remained hospitalized for the duration of the first 12 months of life, adherence to her medication regimen is not in question.
<table>
<thead>
<tr>
<th>Gender</th>
<th>Gestational Age</th>
<th>Renal Abnormalities</th>
<th>Other Abnormalities</th>
<th>Mechanical ventilation</th>
<th>Urine production</th>
<th>Outcome</th>
<th>Author</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>38 wks</td>
<td>Bilateral renal agenesis</td>
<td>No urethral meatus, 2 vessel cord</td>
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<td>Unspecified</td>
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<td>Mauert et al., 1974</td>
<td></td>
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<tr>
<td>Male</td>
<td>40 wks</td>
<td>Multicystic left kidney, absent renal arteries</td>
<td>Anal atresia, absence of external genitalia, 2 vessel cord</td>
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<td>Unspecified</td>
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<td>Koffler et al., 1978</td>
<td></td>
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<tr>
<td>Male</td>
<td>36 wks</td>
<td>Right renal agenesis, small dysplastic right kidney, bladder</td>
<td>TOF, esophageal atresia, 13th rib, peno-scrotal transposition with bilateral gonadal agenesis, redundant rectum, absent left thumb, 2 vessel cord</td>
<td>None</td>
<td>Unspecified</td>
<td>Death at DOL</td>
<td>Cliente et al., 1994</td>
<td></td>
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<tr>
<td>Male</td>
<td>33 wks</td>
<td>Nonfunctioning dysplastic kidneys</td>
<td>Absent external genitalia, imperforate anus, left club foot, 2 vessel cord</td>
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<td>Death at DOL</td>
<td>McNamara et al., 1995</td>
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<tr>
<td>Female</td>
<td>37 wks</td>
<td>Bilateral renal agenesis</td>
<td>Absent renal arteries, absent collecting system</td>
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<td>Death at DOL</td>
<td>Klinger et al., 1997</td>
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<td>35 wk</td>
<td>Bilateral renal agenesis</td>
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<td>PD since DOL</td>
<td>Perea et al., 2004</td>
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<tr>
<td>Female</td>
<td>28 wk</td>
<td>Bilateral renal agenesis, absent bladder</td>
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<td>None</td>
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<td>PD since DOL</td>
<td>Brayfield et al., 2004</td>
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<tr>
<td>Female</td>
<td>34 wk</td>
<td>Bilateral renal agenesis, absent renal arteries, absent ureters</td>
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<td>None</td>
<td>Unspecified</td>
<td>PD since DOL</td>
<td>Beinstock et al., 2014</td>
<td></td>
</tr>
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</table>

Table 1: Demographics and characteristics reported in cases of renal agenesis/abnormalities
Conclusion

In summary, we report an infant with bilateral renal agenesis who has survived more than three years and has been listed for kidney transplant. Without modern day perinatal care, peritoneal dialysis, highly trained nursing, capable medical practitioners, and competent home care, our patient's prospects for survival would have been much lower. The complex care, including peritoneal dialysis, during the perinatal period has evolved so that even those born with bilateral renal agenesis can survive.

References


