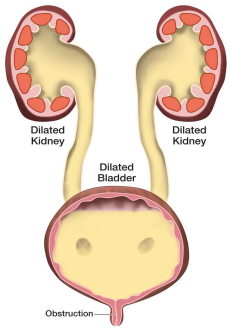
Fetal Echocardiogram Findings in Infants with in Utero Renal Dysfunction

Ghazal Rashidi, MD[1]; Christopher Statile, MD[1,2]; Mounira Habli, MD[3,4]; Stefanie Riddle, MD[1,3,5]

[1]Department of Pediatrics, Cincinnati Children's Hospital; [2]Department of Cardiology, The Heart Institute; [3]Fetal Care Center, Cincinnati Children's Hospital; [4]Department of Obstetrics and Gynecology, Good Samaritan Hospital; [5]Division of Neonatology, The Perinatal Institute

Introduction

- Severe forms of congenital anomalies of the kidney and urinary tract (CAKUT) are associated with significant morbidity and mortality, including pulmonary hypoplasia and renal dysfunction or failure.
- Children and adults with chronic kidney disease have a higher burden of cardiovascular disease related to the effects of cardiorenal syndrome (CRS).
- Little is known about the cardiovascular effects of renal dysfunction in utero and CRS in infants with CAKUT.



https://fetus.ucsf.edu/urinary-tract-obstruction/

Objective

- To describe the major fetal echocardiographic findings in CAKUT to facilitate prediction of cardiovascular instability in neonates.

Methods

- Retrospective cohort study of mother-infant dyads with prenatal diagnosis of isolated CAKUT evaluated in the Cincinnati Fetal Center (January 2010-June 2021).
- Patients with significant congenital heart disease identified on ECHO were excluded.

Results

- Malformations: 49% obstructive uropathies, 32% primary renal dysplasia, 20% bilateral renal agenesis
- Fetal interventions: 74% underwent some type of intervention, 47% serial amnioinfusions, 24% bladder aspiration, and 15% vesicoamniotic shunt
- Post-natal interventions: 59% mechanical ventilation, 33% vasopressors, 32% NO, and 27% dialysis
- Survival: 45% of liveborn infants survived beyond 7 days and 34% survived to NICU discharge/transfer
- Fetal ECHO findings: 38% RV hypertrophy, 37% LV hypertrophy, 30% tricuspid regurgitation, 12% pericardial effusion, 10% abnormal ductus venosus flow, and abnormal mean cardiothoracic ratio

Table 1. Clinical characteristics and outcomes of infants with CAKUT (*n* = 102)

	Value*
Maternal age (years)	28.2±5.6
Male gender	73 (73.7)
Diagnosis:	
Obstructive uropathy	49 (48.5)
Primary renal dysplasia	32 (31.7)
Bilateral renal agenesis	20 (19.8)
Prenatal genetic testing:	
Testing performed	81 (84.4)
Abnormal results	4 (4.9)
Fetal intervention:	
Any intervention	75 (73.5)
Amniocentesis	19 (18.6)
Cystoscopy	3 (2.9)
Bladder aspiration	24 (23.5)
Valve ablation	1 (1)
Single amnioinfusion	20 (19.6)
Serial amnioinfusion (percutaneous)	48 (47)
Serial amnioinfusion (amnioport)	12 (11.8)
Vesicoamniotic shunt	15 (14.7)
Urinoma/Renal cyst drainage	7 (6.9)
Gestational age at birth (weeks)	33.9±3.9
Birth weight (kg)	2.3±0.8
Disposition:	
Intrauterine fetal demise	7 (6.9)
Survival beyond 7 days	45 (44.6)
Survival to NICU discharge or transfer	34 (33.7)
Length of stay (days)	**89 (7-262)
Post-natal interventions:	
Mechanical ventilation	63 (58.9)
Nitrous oxide	34 (31.8)
Pressors	35 (32.7)
Dialysis	29 (27.1)

*Data are presented as *n* (%) or mean ± SD. **Data is presented as median (range).

Table 2. Fetal echocardiographic findings in infants with CAKUT (*n* = 102)

	Value*
Gestational age at first fetal ECHO (weeks)	22.7±3.4
Estimated fetal weight (kg)	0.61±0.43
Cardiothoracic area ratio (*normal <0.35*)	0.37±0.06
Hydrops at presentation	8 (7.9)
Pericardial effusion	12 (11.8)
Tricuspid regurgitation (*at least mild*)	30 (29.7)
Mitral regurgitation (*at least mild*)	4 (4)
Monophasic tricuspid valve	6 (6.1)
Monophasic mitral valve	1 (1)
RV hypertrophy	38 (38)
LV hypertrophy	37 (36.6)
Abnormal ductus venosus flow pattern	10 (10.2)
Umbilical artery pulsatility index	1.04±0.21

*Data are presented as *n* (%) or mean ± SD. RV, right ventricular. LV, left ventricular.

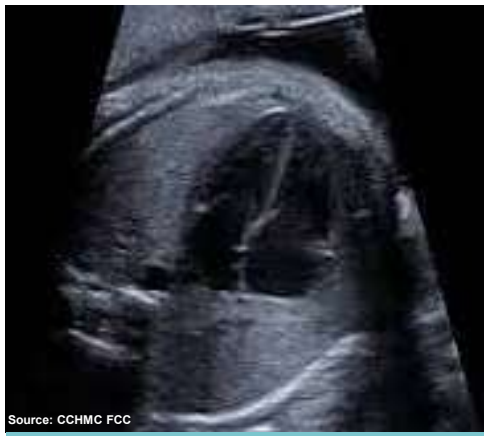


Figure 1. Normal fetal echocardiogram.

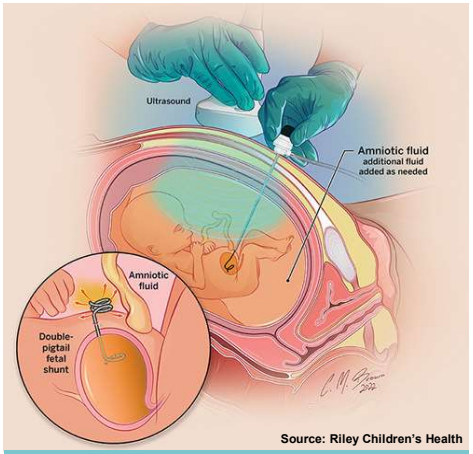


Figure 2. Fetal vesicoamniotic shunting.

Conclusions

- Infants with CAKUT require complex neonatal care, including intensive pulmonary and cardiac support, potentially related to cardiorenal syndrome (CRS).
- Fetal echocardiograms in CAKUT commonly exhibit biventricular hypertrophy, tricuspid regurgitation, and pericardial effusion.
- Next steps include further statistical analysis of echocardiographic findings in relevant subgroups to help predict neonatal course.
- Further studies are warranted to elucidate the post-natal effects of CRS in this population.