Case Study -Autosomal Recessive Polycystic Kidney Disease (ARPKD)

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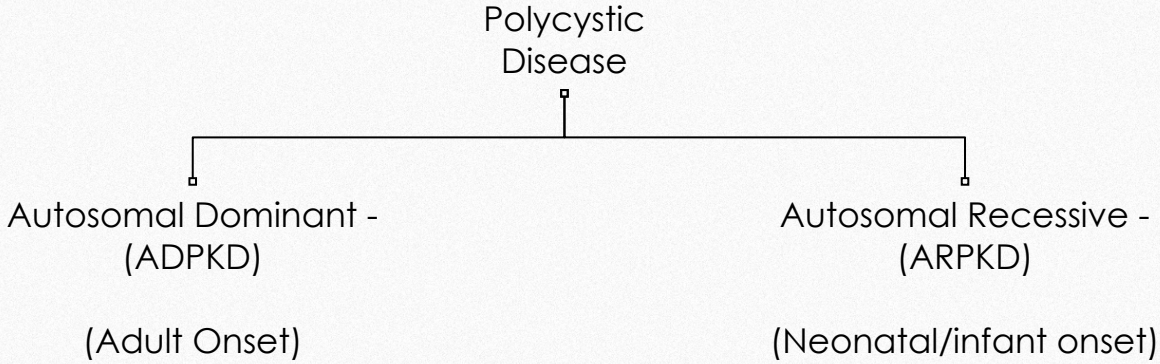
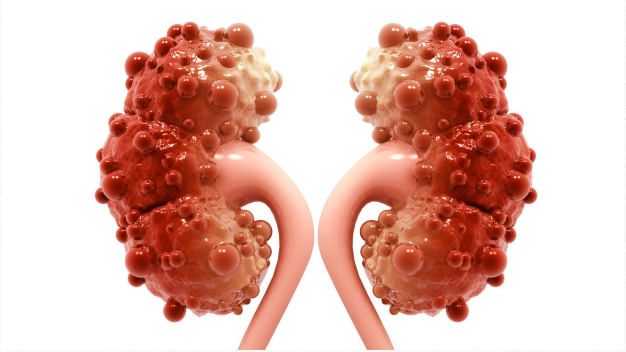
What is Polycystic Kidney Disease (PKD)?

- PKD is a **hereditary cystic kidney disorder** involving formation of multiple fluid-filled cysts.
- Two main types:



- Leads to **renal enlargement, loss of corticomedullary differentiation, and renal failure**.
- Associated with **mutations in the PKHD1 gene** encoding fibrocystin.

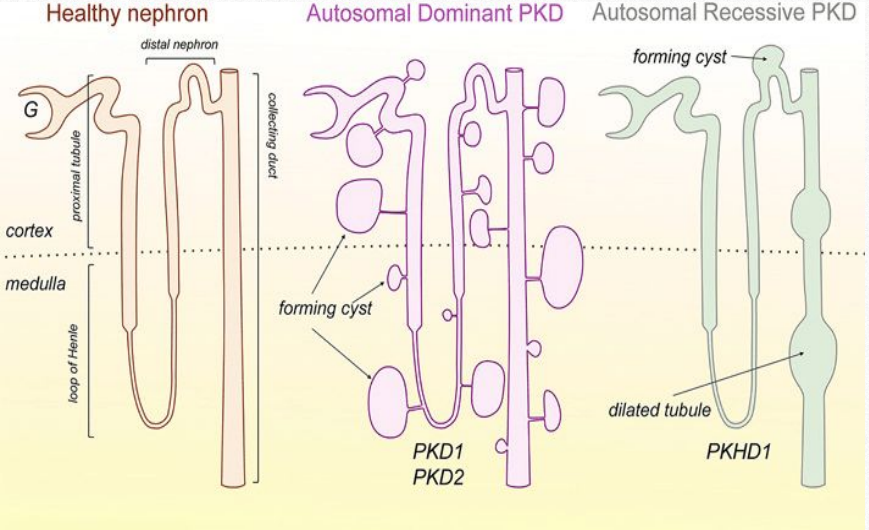
Overview of ARPKD



- Autosomal Recessive Polycystic Kidney Disease (ARPKD) is a rare congenital renal disorder caused by mutations in the PKHD1 gene.
- Characterized by **bilateral** renal enlargement, multiple microcysts, and loss of corticomedullary differentiation.
- In severe cases, may lead to **pulmonary hypoplasia**, renal failure, and portal hypertension.
- Typically manifests prenatally or during the neonatal period and follows an autosomal recessive inheritance pattern.

Pathophysiology

- Mutation in **PKHD1** gene leads to defective **fibrocystin**, disrupting tubular morphogenesis.
- Results in **cystic dilatation of collecting ducts** in kidneys and **ductal plate malformation** in the liver.
- **Renal consequences:** Bilateral nephromegaly, Microcysts (2–7 mm) in cortex and medulla, Impaired renal function and hypertension
- **Hepatic consequences:** congenital hepatic fibrosis and possible Caroli disease



Epidemiology and Prognosis

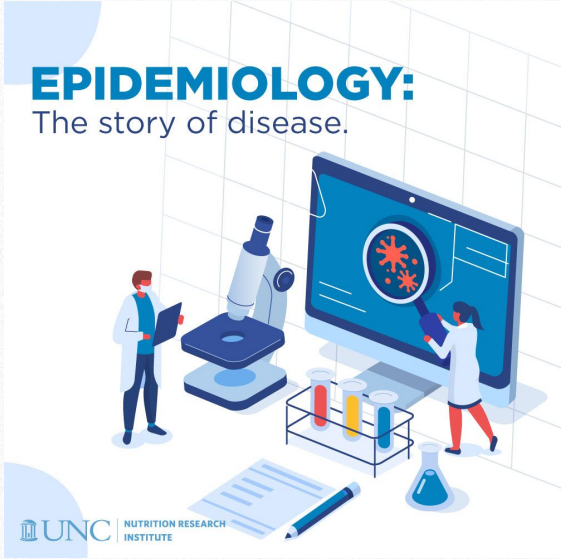
Incidence: ~1 in 20,000 live births.

Inheritance: Autosomal recessive (25% recurrence risk if both parents are carriers).

Mortality: Up to 30% in the neonatal period due to respiratory insufficiency.

Long-term outcomes:

- 50% develop end-stage renal disease by adolescence.
- 80% 10-year survival among neonatal survivors

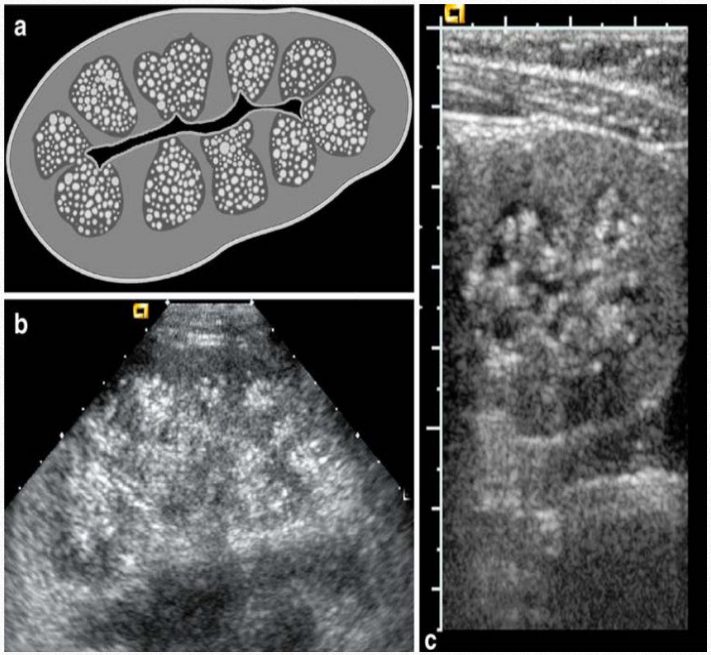


Sonographic Appearance

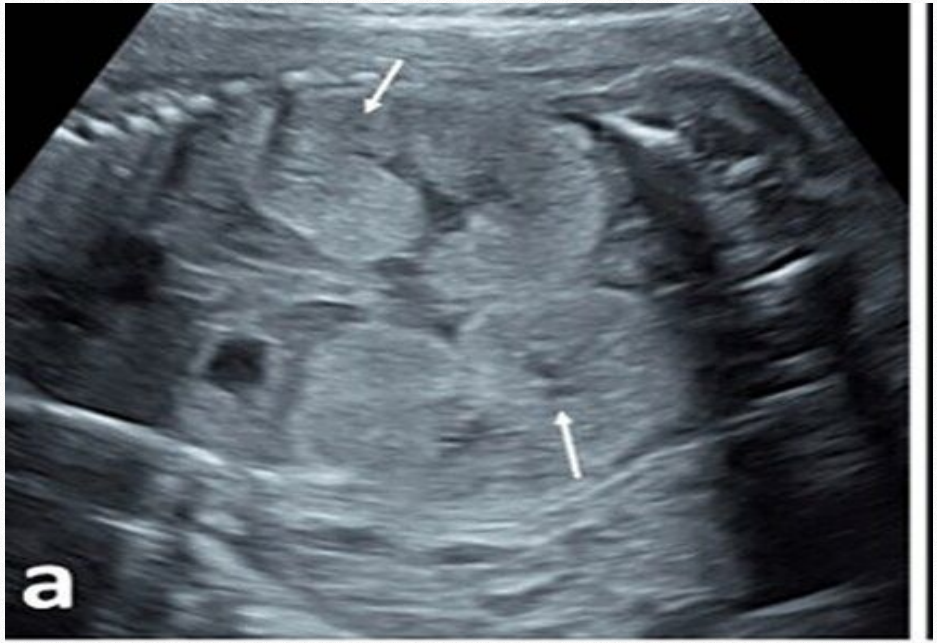
- **Prenatal ultrasonography:**
  Bilaterally enlarged, hyperechoic kidneys
  salt-and-pepper appearance" due to microscopic cysts,
  Loss of corticomedullary differentiation
  Possible oligohydramnios

- **Postnatal ultrasonography:**
  Bilateral nephromegaly
  Diffusely echogenic renal parenchyma
  Multiple tiny cysts (2–7 mm) within cortex and medulla

- **MRI findings:**
  Enlarged kidneys with cysts distributed within **Malpighian pyramids**

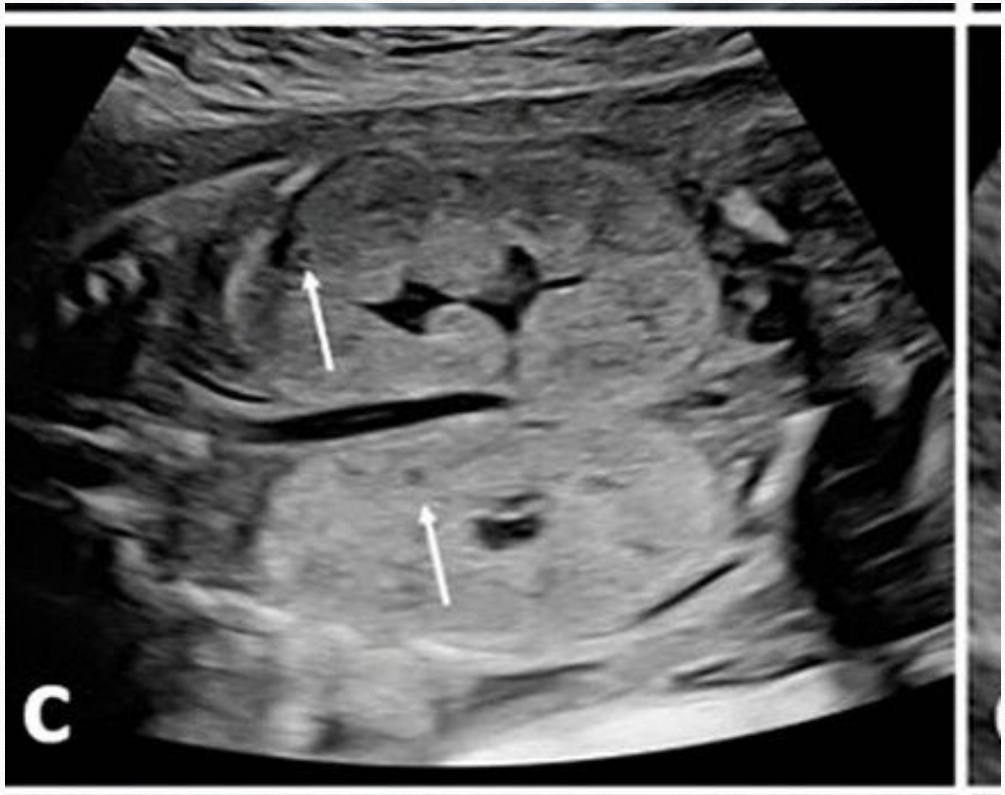


Sonographic Images



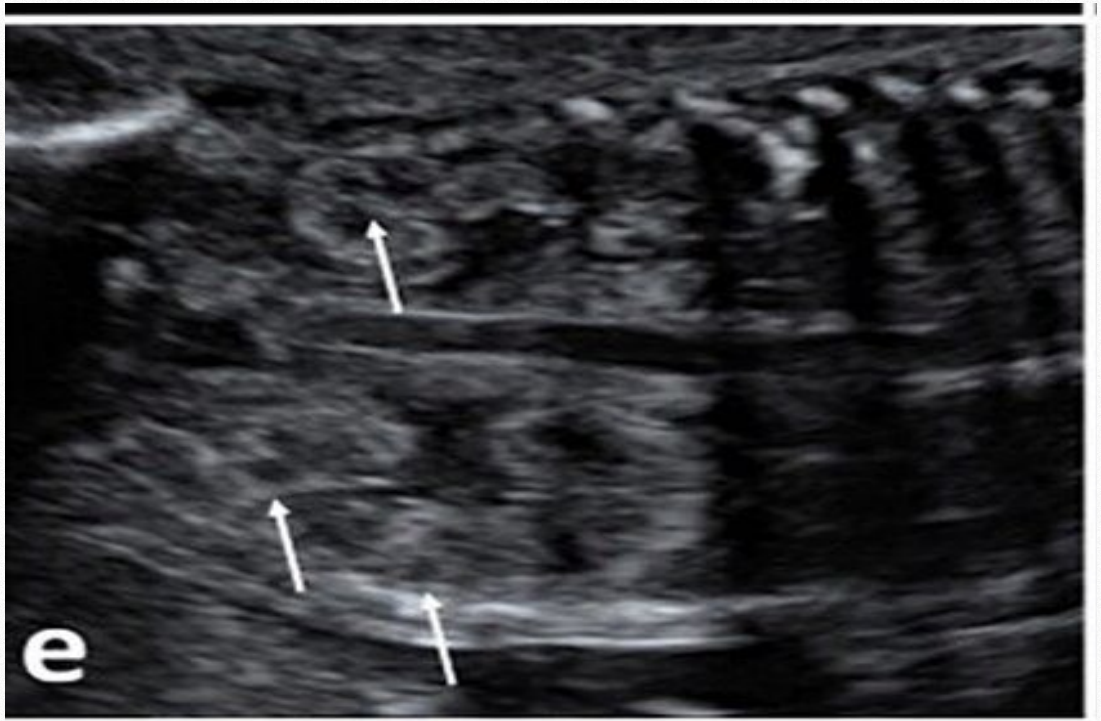
(a) shows fetal kidneys in ARPKD **at 23+3 weeks'**: kidneys present **enlarged, hyperechogenic and with absent corticomedullary differentiation (CMD);** small cysts can be seen in the medulla (white arrow); cysts show a variable size from 1 to 9 mm and a relative increase in size with advancing gestational age;

Sonographic Images



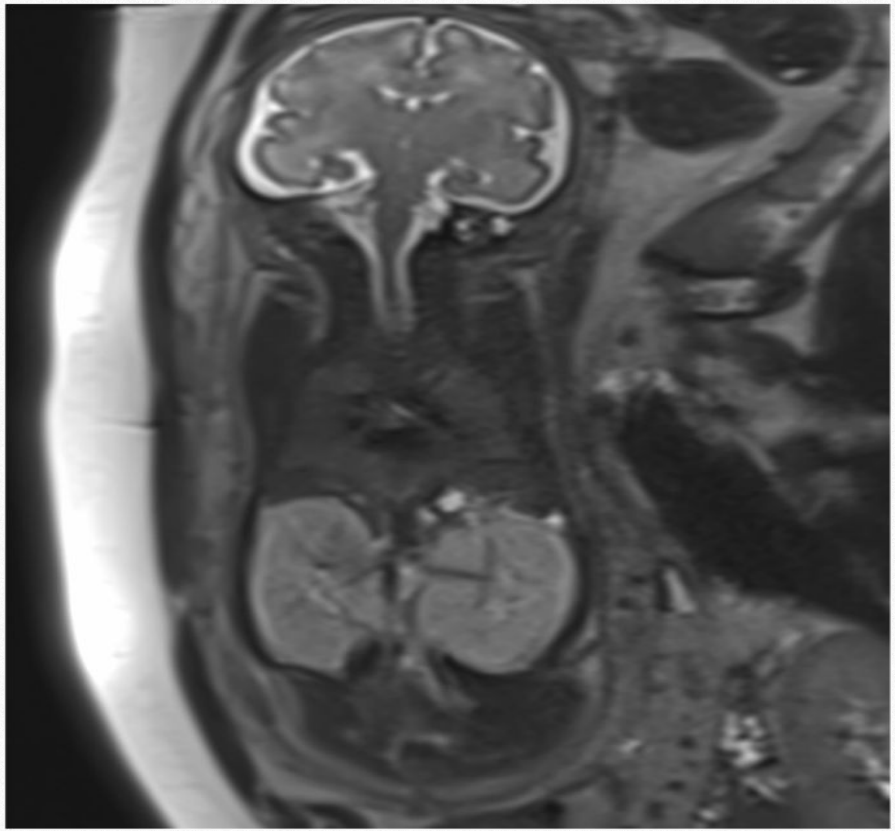
(c) shows kidneys of a fetus with **ARPKD at 24+0 week**s': in this case, kidneys are **enlarged, hyperechogenic with absent corticomedullary differentiation (CMD)** and small cysts (white arrows)

Sonographic Images



(e) shows the kidneys of another fetus with ADPKD at **24+1 weeks':** CMD is preserved with visible cysts (white arrows) predominantly located in the cortex

MRI



Enlarged echogenic fetal kidneys with preserved reniform shape (length: right kidney = 75 mm, left kidney = 78 mm), containing **numerous tiny cysts with loss of the corticomedullary differentiation. Associated severe oligohydramnios.**

Differential Diagnosis (ARPKD)

- **ADPKD** – usually **adult onset**, family history positive, larger cysts
- **Multicystic Dysplastic Kidney (MCDK)** – **unilateral**, non-functioning kidney, irregular cysts
- **Nephronophthisis** – **small kidneys,** corticomedullary cysts, progressive renal failure in childhood
- **Obstructive Cystic Dysplasia** – due to urinary tract obstruction, **asymmetric kidneys**
- **Medullary Sponge Kidney** – dilated collecting ducts, **normal renal size**

Clinical Presentation

Age: 27 days old male neonate

Reason for admission: Fever, foul-smelling urine, and diarrhea for 1 day.

History: Admitted at 2 weeks old for reflux; ultrasound already showed enlarged hyperechoic kidneys.

Physical findings:

- Poor feeding, weak tone
- Puffy face, distended abdomen
- Palpable large kidneys
- Umbilical hernia

Laboratory Results

- **Leukopenia, anemia,** borderline platelets
- **Hyponatremia (Na 117 mmol/L)**
- **Hypoalbuminemia (Alb 2.67 g/dL)**
- **Proteinuria, hematuria, leukocyturia**
- **Blood & urine culture:** *E. coli* positive

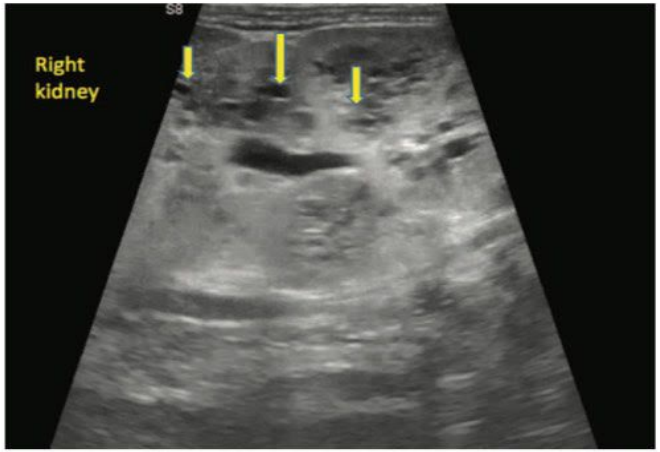


Figure 1. The ultrasound aspect of cystic lesions in the right kidney at the time of diagnosis.

Ultrasound:

- Bilateral nephromegaly
- Cysts 2–7 mm; poor differentiation
- MRI confirmed **bilateral cystic kidneys**

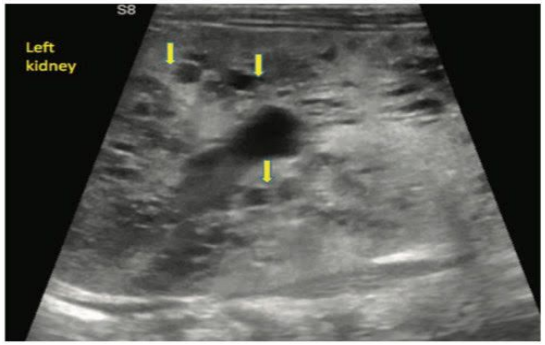
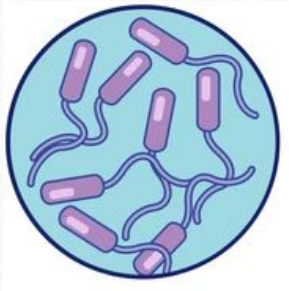


Figure 2. The ultrasound aspect of cystic lesions in the left kidney at the time of diagnosis.

Diagnosis



Final Diagnoses:

1. **Autosomal Recessive Polycystic Kidney Disease (ARPKD)**
2. **Neonatal sepsis secondary to urinary tract infection with *E. coli***

Diagnostic confirmation based on:

- Typical imaging pattern on ultrasound and MRI
- Clinical and laboratory correlation
- Positive bacterial cultures

Therapeutic Management

- **Antimicrobial therapy:** *Meropenem* (10-day course) as per sensitivity report.(E.COLI)
- **Supportive therapy:** Human albumin, blood transfusion, erythropoietin. Sodium supplementation (IV and oral), calcium support.
- **Antihypertensive management:** Furosemide, enalapril, amlodipine, metoprolol.
- **Specialist referral:** Pediatric nephrology for ongoing management

Follow-up and Clinical Outcome

Follow-up period: 1 year and 2 months.

Findings:

- **Blood pressure normalized** under medication.
- Persisting mild proteinuria and microscopic hematuria.
- **Stable first-degree** chronic kidney disease (CKD).
- **No further urinary infections.**
- Ultrasound showed **no new cyst formation**

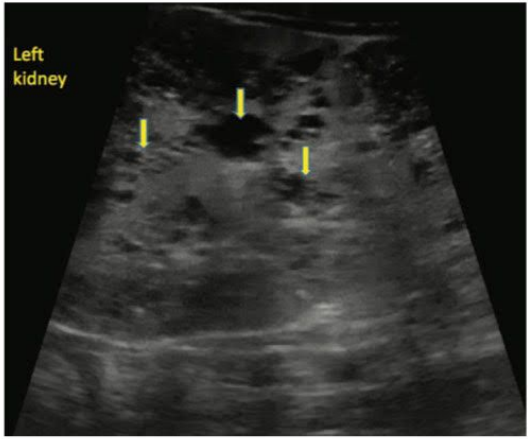


Figure 4. The evolution of the cystic lesions in the left kidney (Ultrasound aspect - 1 year and 2 months of age).

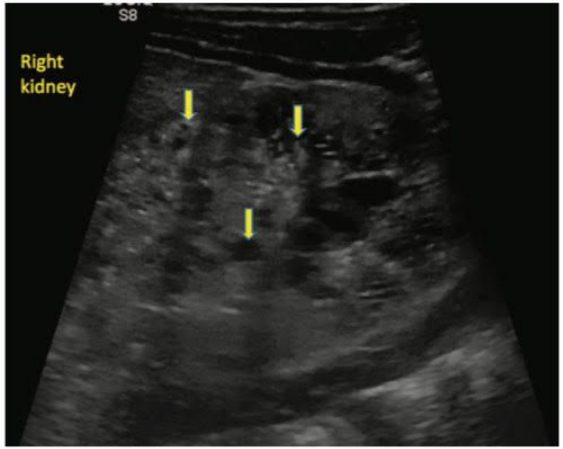
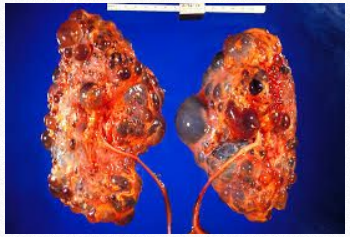


Figure 3. The evolution of cystic lesions in the right kidney (Ultrasound aspect - 1 year and 2 months of age).

Discussion

- ARPKD is a **major cause of chronic kidney disease in neonates**.
- Early diagnosis through **ultrasonography and MRI** allows timely intervention.
- **Hypertension and infection** are common complications requiring aggressive management.
- Long-term prognosis depends on **renal function preservation** and **infection control**.
- Early detection, antibiotic therapy, and multidisciplinary follow-up improve survival

Key Sonographic Points for Pediatric Practice



- **Bilateral renal enlargement** with increased echogenicity in neonates warrants ARPKD consideration.
- **Absence of corticomedullary differentiation** is a hallmark feature.
- **Cysts are typically microscopic** and uniformly distributed throughout the kidneys.
- **Serial ultrasound follow-up** is critical to monitor renal growth and parenchymal changes.
- Doppler studies can assist in assessing **renal perfusion** and **hypertension management**.

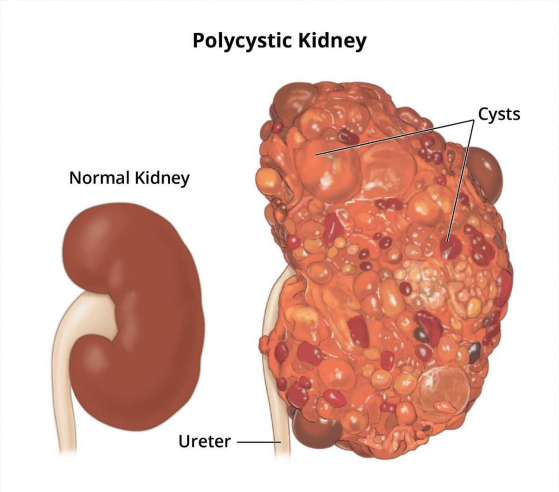
Conclusion

ARPKD is a **rare, inherited renal disorder** with variable prognosis in neonates.

Sonography plays a pivotal role in **early detection and monitoring**.

Despite high neonatal mortality rates, **favorable outcomes** are achievable with prompt diagnosis, infection control, and specialist care.

Continuous follow-up is vital to manage **progressive renal insufficiency** and **associated hypertension**.



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