

# Association of unilateral renal agenesis and genital anomalies

Amin J. Barakat

*Georgetown University Medical Center, Washington, VA, U.S.A.*

**key words:** unilateral renal agenesis, ovarian agenesis, unicornuate uterus

## SUMMARY

**Background:** Congenital unilateral renal agenesis occurs in 0.93–1.8 per 1000 autopsies, and is usually diagnosed on an incidental imaging examination. Genital anomalies occur in 37–60% of females and 12% of males with congenital unilateral renal agenesis. Abnormalities in females include agenesis, duplication, rudimentary, unicornuate or bicornuate uterus, double or absent vagina, absent or hypoplastic ovary, absent fallopian tube, abnormal external genitalia and others

**Case Report:** A 16-year-old female with congenital unilateral renal agenesis, ipsilateral ovarian agenesis and unicornuate uterus is presented. Abdominal and pelvic ultrasound revealed a hypertrophied right kidney measuring 13.0 cm, a normal right ovary, and absent left kidney and ovary. Computerized tomography of the abdomen and pelvis confirmed absence of the left kidney and ovary and revealed a unicornuate uterus with absent left horn.

**Conclusions:** Recognition of a congenital solitary kidney is important in order to monitor the affected individual for urinary infection, obstruction or calculi and warn the individual to avoid contact sports and similar activities that might endanger the solitary kidney. Physicians should be aware of the association of congenital unilateral renal agenesis, ovarian agenesis and unicornuate uterus. Early detection of a congenital solitary kidney by routine prenatal ultrasonography or incidental imaging should alert physicians to look for associated genital anomalies and avoid unnecessary procedures and surgery in patients presenting with abdominal and pelvic complaints.

## BACKGROUND

Congenital unilateral renal agenesis occurs in 0.93–1.8 per 1000 autopsies, and is usually diagnosed on an incidental imaging examination. Genital anomalies occur in 37–60% of females and 12% of males with congenital unilateral renal agenesis. Abnormalities in females include agenesis, duplication, rudimentary, unicornuate or bicornuate uterus, double or absent vagina, absent or hypoplastic ovary, absent fallopian tube, abnormal external genitalia and others

Author's address: Amin J. Barakat, MD, FAAP, Clinical Professor of Pediatrics/Nephrology, Georgetown University Medical Center, Washington, D.C., 107 North Virginia Avenue, Falls Church, VA 22046, U.S.A., email: aybarakat@aol.com

## CASE REPORT

The patient is a 16-year-old white female who presented with severe left lower quadrant abdominal pain of one-day duration. She gave no history of fever, vomiting, diarrhea or urinary symptoms, and her menstrual period was regular. Family history was essentially negative. Physical examination revealed a healthy looking adult female with a weight of 112 lbs, height 62 inches and blood pressure 90/60. She had severe left lower quadrant abdominal tenderness. Vaginal examination revealed no masses or detectable abnormalities. Hemoglobin was 14.3 gm%, hematocrit 44% and white blood cell count 11,000 with normal differential and platelets. Urinalysis showed a specific gravity of 1.015, pH 6, and negative protein and cells. Serum urea nitrogen was 11 mg%, creatinine 0.9 mg% and normal chemistries.

Abdominal and pelvic ultrasound revealed a hypertrophied right kidney measuring 13.0 cm, a normal right ovary, and absent left kidney and ovary. Computerized tomography of the abdomen (Figure 1) and pelvis (Figure 2) confirmed absence of the left kidney and ovary and revealed a unicornuate uterus with absent left horn. A Tc-99m-Mag 3 renal scan (Figure 3) revealed normal perfusion and function of the right kidney with no evidence of a functioning left kidney. The abdominal pain resolved spontaneously. At age 17, she presented with a missed period and a positive pregnancy test. The patient and her parents decided to terminate the pregnancy.

## DISCUSSION

Congenital unilateral renal agenesis occurs in 0.93–1.8 per 1000 autopsies [1–3]. The condition is usually diagnosed on an incidental imaging examination. The left kidney is more commonly involved than the right, and males are affected more than females. Congenital solitary kidney is compatible with



**Figure 1.** CT scan of the abdomen showing absent left kidney and hypertrophic right kidney (arrow).



**Figure 2.** CT scan of the pelvis showing a normal right ovary (arrow), absent left ovary, and a unicornuate uterus with absent left endometrial canal (arrow).



**Figure 3.** Tc-99-m Mag 3 renal scan showing a hypertrophied right kidney measuring 13 cm, normal ureter and bladder. No perfusion or function of the left kidney.

longevity, but may be prone to disease such as pyelonephritis, obstruction and calculus formation [4,5]. Additionally, the kidney may be ectopic or malrotated in 5 to 10% of cases. Abnormalities of other organ systems occur in 47% of patients with kidney and urinary tract anomalies [6]. Around half of patients with congenital unilateral renal agenesis have associated urological anomalies including vesicoureteral reflux, ureterovesical junction obstruction, uretero-pelvic junction obstruction and others [7], and 25% of them have associated cardiovascular, gastrointestinal, skeletal abnormalities [3].

Renal agenesis may be isolated or may be a part of a multisystem syndrome. Winter et al [8] described the association of renal aplasia or hypoplasia, vaginal atresia and anomalies of the ossicles of the middle ear. When skeletal defects are present, the anomaly is referred to a MURCS association (MULLERian aplasia, Renal aplasia, Cervico-thoracic Somatic dysplasia). Renal agenesis and/or ectopy occur in 88% of MURCS patients [9]. Renal aplasia in these patients may be attributed to alterations of the blastema of the cervicothoracic somites and the pronephric duct by the end of the 4th week of fetal life, while re-

nal ectopy, to a partial pronephric duct induction. The combination of absence of the vagina, abnormal uterus, renal and skeletal anomalies is known as the Mayer-Rokitanski-Kuster-Hauser syndrome [10]. Unilateral renal agenesis was also reported in patients with Familial Kallmann syndrome, an X-linked syndrome of anosomia, hypogonadotropic hypogonadism [11].

The patient in this report had unilateral renal agenesis associated with ipsilateral ovarian agenesis and unicornuate uterus with absent uterine horn on the same side. Seventy to 89% of patients with unilateral renal agenesis may have associated genital anomalies [12,13]. Renal anomalies are described in 40% of cases of mullerian aplasia [10], and 40% of women with unicornuate uterus [14]. Woolf and Allen [15] reported 4 cases of unicornuate uterus of which 3 lacked a kidney on the same side of the mullerian agenesis, the fourth case had a pelvic kidney. Three out of 22 females with unilateral renal agenesis described by Ashley and Mostofi [16] also had complete absence of one ovary, the fallopian tube on the same side and a hemiuterus. Rolen et al [17] found 67% of patients with unicornuate uterus to have ipsilateral renal agenesis, and 13% of them have pelvic kidney. Li et al [18] reported renal agenesis in 30% of women with mullerian duct anomalies, and 80% of women with uterus didelphys. Unilateral renal agenesis has been described also in association with a rudimentary uterine horn, fallopian tube and ovary in an inguinal hernia sac [19].

Genital anomalies occur in 37–60% of females and 12% of males with congenital unilateral renal agenesis [3]. Abnormalities in females include agenesis, duplication, rudimentary, unicornuate or bicornuate uterus, uterus didelphys (double uterus, double cervix and double vagina), double or absent vagina, absent or hypoplastic ovary, absent fallopian tube, persistent Gartner's duct cyst, and abnormal external genitalia [3,13,18]. A double uterus with unilaterally obstructed hemivagina is also a rare association [20]. Fertility might not be impaired in the presence of mullerian agenesis; however, premature labor, spontaneous abortion and breech presentation occur more frequently [21]. Abnormalities in males include cryptorchidism, seminal vesicle cyst, hypoplastic vas, unilateral prostatic agenesis, cystic testicular dysplasia, and hypospadias [3].

The development of the urinary tract is a sequential and integrated process of the primitive renal elements. Abnormalities of this system result from defects occurring during embryogenesis between 15 and

94 days of fetal life. Interaction between environmental factors such as maternal illness and exposure to toxic agents, as well as genetic factors around this period result in malformations of this system [22]. Abnormalities of the mullerian system, ovaries and kidney have the same embryologic defect since the wolffian and mullerian ducts develop in close anatomical relationship [16]. A defect in the entire region of the urogenital ridge formed from the gonad and mesonephros could account for this failure in multiple organ development. In 1941, Gruenwald [23] demonstrated that resection of the Wolffian duct resulted in absent kidney and fallopian tube and unicornuate uterus.

Unilateral renal agenesis may be an expression of a single dominant gene [24]. The association of mullerian agenesis and renal agenesis could be an autosomal dominant disorder [25–27]. Buchta et al [26] described many generations of two families with hereditary renal adysplasia with or without mullerian anomalies. They suggested dominant inheritance. Wiersma et al [13] reported a mother and daughter with double uterus, two cervices, a partial vaginal septum, unilateral hematocolpos and ipsilateral renal agenesis. Knudsen et al [28] described a 38-year-old man with unilateral renal agenesis and ipsilateral seminal vesicle cyst. His sister had an embryologically analogous malformation consisting of Gartner duct cyst, bicornuate uterus and renal agenesis. Schimke and King [25] observed a family with three-generation transmission with renal agenesis/dysgenesis and uterine anomaly. They referred to it as 'hereditary urogenital adysplasia', and suggested autosomal dominant inheritance with decreased penetrance and variable expressivity. The authors suggested that the developmental defects of the mesonephric and para-mesonephric ducts might have a common genetic basis. Doray reported renal adysplasia in three generations [29]. McGillivray et al [30] suggested searching segment 5q11.2-q13.3 for the gene responsible for hereditary renal adysplasia. McCallum et al [31] postulated that unilateral renal agenesis and congenital bilateral absence of the vas deferens might have a non-cystic fibrosis mutation-mediated genetic basis that leads to abnormal development of the entire mesonephric duct before seven weeks of gestation.

## CONCLUSIONS

Prenatal diagnosis of the solitary kidney and other renal abnormalities by ultrasound is possible as early as 12 to 16 weeks of gestation [32]. Early detection of a congenital solitary kidney by routine prenatal ultrasound or by incidental imaging studies should alert

the physician to look for associated genital anomalies. This is particularly important in young females since one of every three with renal agenesis will also have a significant anomaly of the uterus, ovary or vagina [3]. Such knowledge is useful in avoiding unnecessary procedures and surgery in patients presenting with abdominal or pelvic complaints. Recognition of a congenital solitary kidney is also important in order to monitor the affected individual for urinary infection, obstruction or calculi and warn the individual to avoid contact sports and similar activities that might endanger the solitary kidney.

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