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Unilateral Renal Hypoplasia with Contralateral Ureteral Duplication in a Child

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Description

Unilateral renal hypoplasia and contralateral ureteral duplication are individually uncommon congenital anomalies of the urinary tract, and their coexistence in a single pediatric patient represents a rare and complex urological condition. Both anomalies arise during early embryonic development of the kidneys and ureters and can significantly affect renal function, urinary drainage, and susceptibility to complications such as Urinary Tract Infections (UTIs), Vesicoureteral Reflux (VUR), and obstruction. The recognition, diagnosis, and management of these anomalies require a comprehensive understanding of renal embryology, functional assessment of renal units, and careful monitoring of the child's clinical course.

Renal hypoplasia refers to the underdevelopment of one or both kidneys, characterized by a reduced number of nephrons and smaller renal size without dysplastic elements. In unilateral renal hypoplasia, one kidney is significantly smaller and less functional or non-functional, while the contralateral kidney typically compensates through hypertrophy and increased workload. This anomaly results from incomplete or abnormal interaction between the ureteric bud and the metanephric blastema during nephrogenesis. Depending on the degree of hypoplasia, the affected kidney may retain some degree of function or may be entirely non-functional.

Ureteral duplication, on the other hand, results from the development of two ureteric buds from the mesonephric duct or an early bifurcation of a single ureteric bud. The result is two ureters draining a single kidney, either partially (incomplete duplication) or completely (complete duplication) with separate insertion sites into the bladder. Complete duplication is frequently associated with additional anomalies such as ectopic ureteral insertion, ureterocele, or vesicoureteral reflux. Duplication may remain asymptomatic or may predispose to urinary stasis, infection, reflux, and obstruction, especially in the upper pole moiety.

Children with these anomalies may present with a variety of clinical signs. Commonly, they are evaluated following recurrent febrile urinary tract infections, discovered incidentally during imaging for unrelated concerns, or identified on prenatal ultrasound that detects unilateral renal size discrepancy or hydronephrosis. In some cases, poor growth, failure to thrive, or persistent hypertension in early childhood may be the first signs of underlying renal pathology.

Diagnostic evaluation begins with ultrasonography, which typically reveals a small, echogenic, poorly defined kidney on one side, suggestive of hypoplasia, and a duplicated collecting system on the other, often evidenced by a prominent central renal sinus with two separate collecting systems or ureters. If hydronephrosis is present, it may indicate ureterocele or obstruction in one of the moieties of the duplicated kidney. Ultrasound may also reveal compensatory hypertrophy of the

contralateral kidney. Dimercaptosuccinic Acid (DMSA) renal scintigraphy provides functional assessment and can confirm the presence and extent of renal hypoplasia by quantifying differential renal function. A hypoplastic kidney typically contributes less than 10% of total renal function, sometimes approaching zero. The duplicated kidney's function may be divided unequally between its two moieties, especially if one is obstructed or dysplastic.

Voiding Cystourethrogram (VCUG) is essential to assess for vesicoureteral reflux, particularly in the setting of recurrent UTIs. Reflux is more commonly associated with the lower pole of a duplicated system. If ectopic ureter or ureterocele is suspected, Magnetic Resonance Urography (MRU) or computed tomography urography may provide better anatomic delineation. MRU has the added advantage of functional imaging without radiation exposure.

Management strategies depend on the child's symptoms, renal function, presence of infection, and degree of obstruction or reflux. In many cases, unilateral renal hypoplasia requires only monitoring, particularly if the contralateral kidney demonstrates good function and there is no evidence of infection or hypertension. However, regular follow-up with renal function monitoring, blood pressure checks, and urinalysis is critical. If the hypoplastic kidney is non-functional and becomes a source of infection or uncontrolled hypertension, nephrectomy may be indicated.

A clinical case can help illustrate these principles. A six-year-old boy presented with recurrent febrile UTIs since infancy. Prenatal ultrasound had shown a small left kidney and right-sided hydronephrosis. Postnatal evaluation revealed a hypoplastic left kidney with no evidence of obstruction or function on DMSA scan. The right kidney showed complete ureteral duplication with a ureterocele obstructing the upper pole moiety and grade III reflux into the lower pole ureter. After multidisciplinary evaluation involving pediatric nephrology and urology, the child underwent cystoscopic incision of the ureterocele, followed by antibiotic prophylaxis. As infections persisted and the upper pole moiety remained non-functional, a right upper pole heminephrectomy and ureterectomy were performed. Follow-up imaging showed resolution of hydronephrosis, and the child remained infection-free with stable renal function over a two-year period.

Unilateral renal hypoplasia with contralateral ureteral duplication in a child represents a rare and challenging clinical scenario. While each anomaly may be benign in isolation, their combination can significantly compromise renal function and increase the risk of complications. Accurate diagnosis through detailed imaging, functional assessment, and vigilant monitoring is essential. Treatment must be individualized based on anatomy, function, and symptomatology, with a multidisciplinary team ensuring optimal outcomes and preservation of renal health throughout childhood and beyond.

Conclusion

Pediatric bladder polyps are an uncommon but important cause of recurrent hematuria and dysuria in children. Their clinical presentation can mimic more common urological conditions, leading to delays in diagnosis. Ultrasonography and cystoscopy play crucial roles in identifying and managing these lesions. With timely endoscopic resection, the prognosis is excellent, and recurrence is rare. Clinicians should maintain a high index of suspicion for bladder polyps in children with unexplained persistent lower urinary tract symptoms to ensure accurate diagnosis and effective treatment.