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"COMMON URETERIC BUD ANOMALIES" EMBRYOLOGICAL BASIS AND ITS CLINICAL IMPORTANCE

Ganesh Elumalai and Danisha Sanicharan

Department of Embryology, College of Medicine, Texila American University, South America.

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ABSTRACT

A ureteric bud anomalies occurrence in the world's population is very common. One in every thousands babies born usually have some form of ureteric bud congenital anomaly. However these congenital anomalies can vary from individual to individual due to science stating that during embryological development, the ureteric bud is responsible for the collecting system, which includes the major and minor calyces of the kidney, the ureter and the bladder. Congenital anomalies can vary to the abnormal development in any of these stated parts.

Introduction

The ureteric bud is a projection formed in the mesonephric duct during the embryological development of the urinary and genital systems.[1-3]The ureteric bud is also known as the mesonephric diverticulum.The reteric bud forms the ureter. As embryological development continues, the ureteric bud forms a drainage channel for urine on the left and right side of the the urinary system, this channel is known as the ureter.[4-6]The ureter is originated from the mesonephric blastema. There are many variations of anomalies that can occur during embryological development of the ureteric bud. These congenital anomalies may vary in both males and females depending on its origination[7]. However, there are ureteric bud anomalies that are found in both gender but have a higher prevalence in one gender more than the other. Some of the ureteric bud anomalies found in both males and females include: Renal Agenesis, Renal Dysplasia, Megaureter, Ureterocele, Ectopic ureter,Duplicated ureter and obstruction of the UPJ (ureteropelvic junction)[8-10]. The anomalies may be originated on the distal or proximal end of the ureter and can either be unilateral or bilateral, meaning it affects one or both ureters.

Incidence

The epidemiology of the occurrence of ureteric bud anomalies may vary depending upon the particular anomaly. In terms of anomalies relating to the duplication of the ureter, this occurs in less than 1% of the population, but is mostly common in children UTIs, which has an incidence of 8%.[11] The incidence for ureteroceles ranges from 1 in every 5000 to 12000 persons. 10% can be bilateral, while 60 to 80% are ectopic ureters.

Ontogenesis for the normal development of Ureter

To understand the concept of the abnormal development of the ureteric bud, the basic normal development of the ureteric bud is fundamental and must be initially understood. The development of the ureter begins within the fourth week of the gestation period. The ureteric bud divides from the mesonephric duct, also commonly known as the Wolffian duct[12-13]. The ureteral bud then extends into the mesonephric blastema. The ureteric bud is responsible for the formation of the entire renal collecting system, which begins from the ureteral orifice to the collecting ducts of the kidney. The mesonephric duct is integrated into the developing bladder at the distal portion of the ureteral bud. The ureteral orifices travels superior and laterally and takes its normal position on the trigone. The distal portion of the mesonephric duct travels inferior and medially and is incorporated into the neck of the bladder[14-16] This occurrence differs in both males and females, in the male fetus, it develops into the seminal vesicle, vas deferens and epididymis and in the female fetus it progress into the Gartner duct, which is situated between the vagina and urethra[17].

Ontogenesis for the Ureter anomalies

There are various abnormalities that can occur in the ureteric bud. This can be classified due to location and position. In this segment there is an elaboration of the various occurrences of ureteric bud anomalies in both males and females[18-19]. Renal agenesis is a condition whereby the unilateral and bilateral kidneys in the fetus have failed to develop. Bilateral renal agenesis occurs when both the kidneys fail to develop during the gestation period, while unilateral kidney occurs when there is only completed development of one kidney during the gestation period of pregnancy[20]. This occurs when the ureteric bud fails to develop in the early stages, specifically the fourth week of fetal development. This can occur due to various reasons, one of the most common reasons being hereditary. Renal Dysplasia or muliticystic dysplastic kidney is condition whereby the kidney consists of cysts of various sizes all over the kidney[21]. According to theory, renal dysplasia occurs due to an abnormal induction of the mesonephric mesenchyme by the ureteral bud This abnormal occurrence may be due to an abnormality in the formation of the mesonephric duct, the malformation of the ureteric bud or degeneration of the ureteric bud around the fourth or fifth week of the gestational period[22].

Tele:
E-mail address: coolncandy@gmail.com

Megaureter is a congenital abnormality whereby the ureter is wider than 3/8 of an inch. This condition can be classified under primary and secondary megaureter. Primary being that this enlargement or dilation can occur in the ureter itself and secondary where is protrudes downward and results in the urinary bladder being blocked[23-25] This anomaly is more frequent in males and can be either unilateral where is affects on ureter or bilateral whereby it affects both[26]. During the fourth week of embryological development of the ureter, specifically the distal portion of the ureter, the longitudinal muscles are absent, the circular muscles are enlarged and there is a significant increase in the connective tissue deposition, all of which results in thee congenital anomaly, megaureter.

Ureterocele is a congenital anomaly whereby the bladder end of the ureter is sacculated, the can usually occur either inside or outside of the bladder. This congenital anomaly is more prevalent is females than it is in males[27]. This condition can either be bilateral or unilateral and usually associated with other conditions such as vesicureteral reflux or due to obstruction of the bladder outlet. Vesicureteral reflux refers to the backward flow of urine from the bladder into the kidney. The embryological basis behind the formation of Ureterocele is still unknown but however theories do exist[28-29]. During the fourth week of embryological development of the bladder and trigone, there is some form of obstruction to the ureteral orifice with the incomplete termination of the chwalla's membrane. This membrane separates the ureteric bud from the urogenital sinus, which is being formed. During development of the ureteral orifice the chwalla's membrane have incompletely perforated, resulting in Ureterocele

Ectopic ureter is a congenital anomaly whereby the ureter terminates at a different site other than the urinary bladder. This anomaly may occur with the combination or Ureterocele[30-32] In males, they may suffer from epididymitis due to the direct drainage of urine from the ureter directly in to the vas deferens or seminal vesicle. In females, there is uncontrollable leakage of urine due to the ectopic ureter, which opens below the sphincter in the urethra, which closes so that urine cannot pass[33].

Duplicated ureter is a congenital anomaly whereby during embryological development, the ureteric bud splits or bifurcates which forms two ureters that drains into one kidney. As known, the embryological development of the ureter begins around the fourth week. There is a ureteric bud which arises from the mesonephric duct, this later forms the ureter and other parts of the collecting system[34]. In the case of duplicated ureter, the ureteric bud from the mesonephric duct bifurcates which forms two ureters instead of one. This anomaly can either occur on the right or left side or even on both side, this is called bilateral ureter duplication. Duplication of ureter is more prevalent in females than males[35-36].

Urethral Atresia is a congenital anomaly whereby there is an absence of the ureter or the ureter may fail to reach or extend to the bladder. This can either be unilateral or bilateral.

Obstruction of the ureteropelvic junction is a condition whereby there is a complete or partial blockage at the junction of the kidney and ureter. During the fourth week of embryological development, the muscles surrounding the ureteropelvic junction have developed abnormally which can lead to partial or total blockage (obstruction)[37-39].

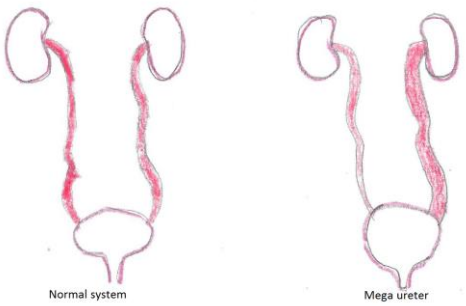

Figure 1. Showing normal ureter in contrast with unilateral megaureter. The megaureteroccured on the left side only which makes it unilateral.

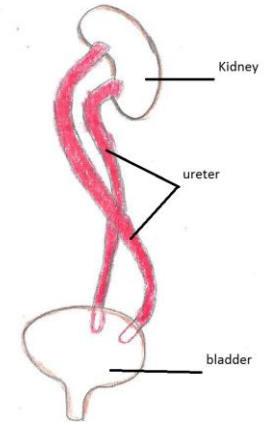

Fig 2. Showing unilateral duplicated ureter whereby the ureter splits or bifurcates and is attached to one kidney.

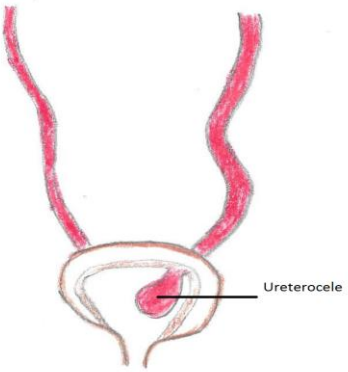

Fig 3. Showing Ureterocele formation at the juction of the ureter and internal bladder.

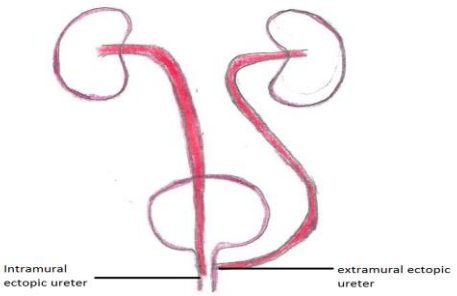

Fig 4. Showing different locations of Ectopic Ureters.One located ousite of bladder(extramuralectopic kidney) and the other is located inside the bladder(intramuralectopic kidney).

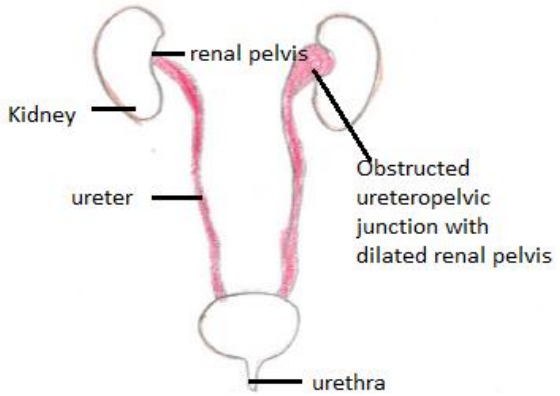

Fig 5. Showing obstruction of ureteropelvic junction at the renal pelvis and the ureter on the left side(unilateral).

Discussion

In an effort to research about the different ureteric bud anomalies found in both males and females, concepts were grasped in the fields of the normal and abnormal embryological development of each individual congenital anomaly[40-41]. In each individual congenital anomaly the prevalence in the genders in which it occurs differs from anomaly to anomaly. Examples of this were seen in Duplicated ureter; females have a higher prevalence than males, with a ratio of 6:1 of females to males respectively according to patient.info.com[42]. Also in the case of Ureteroceles the prevalence in females happens to be higher than males. In contrast, in the obstruction of the ureteropelvic junction, the ratio of male to female is 2:1 respectively. In the case of megaureter , males have a higher prevalence of having this abnormality[43-44] Due to these findings it is quite safe to say that according to the specific abnormality that is being discussed, one gender usually has a higher prevalence of the occurrence of the particular abnormality over another gender. In this study, it is learnt that the ureteric bud does not only form the ureter but also a section of the bladder and major and minor calyces of the kidney, these structures in turn forms the collecting system of the urogenital systems[45]. The most common of all of the ureteric bud malformations, which have been elaborated, is Duplicated ureter, which has an incidence of 1% of the entire world's population. It is also found that the least common ureteric bud anomaly according to patientinfo.com is Ureteral Atresia, where there is a complete absence of one or both ureters. Each one of these congenital anomaly can either be unilateral where it occurs only on one side or bilateral whereby it occurs on both sides. It is found that one main reason for the occurrence of ureteric bud anomalies is hereditary, meaning it can be passed from through genetic information[46].

Treatments of these congenital anomalies can be complicated depending on the severity of the anomaly along with the possibility whereby it is accompanied buy other malformations. In the case of renal agenesis depending on if it is bilateral, a patient will need a kidney transplant surgery[47]. In the case of megaureter, if it is not severe antibiotic prophylaxis is administered, however if it is severe cases ureterostomy is required which allows the ureter to decrease in size, it is tailored and reimplanted to function normal. In Ureterocele, antibiotics are given to prevent further infection and a surgical repair is done by removing the Ureterocele and attaching the ureter back to the bladder.

In the case of ectopic ureter, a surgical procedure is carried out to correct the placement of the ureter to the urinary bladder. In ureteral duplication there is a surgical procedure to correct the placement of ureter as well there is possible removal of one of the bifurcated ureter[48].

Conclusion

In conclusion of this study, due to researches found, ureteric bud anomalies can vary depending on the area of the collecting system in which it affects. Ureteric bud anomalies have one thing in common whereby they can either be unilateral or bilateral however the functional aspect in which it affects may differ. Ureteric bud anomalies frequently occurs and is not very uncommon, however there can be different variation of the occurrence.

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