



Urogenital anomalies in human male fetuses

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Accepted 6 February 2004

Abstract

Background: There are few studies in the literature performed in human fetuses evaluating the incidence of genitourinary anomalies. *Aims:* Analyze the incidence of congenital urogenital malformations in human male fetuses. *Study designs and subjects:* We analyzed 166 human male fetuses well preserved. The gestational age was determined in weeks post conception (WPC) according to the foot length criterion and ranged from 10 to 35 WPC. The fetuses were dissected with the aid of a stereoscopic lens with $2.5 \times$ magnification. We performed abdominal and pelvic incisions to expose the urogenital organs. We studied the incidence of renal, ureteral, vesicle, urethral, testicular, epididymal, vas deferens, prostate and penile anomalies. *Results:* Of the 166 fetuses, 7 (4.2%) presented some kind of anomaly of the urogenital system. Renal anomalies were found in two fetuses (1.2%). Unilateral renal agenesis was found in a 25 WPC fetus. Horseshoe kidney was found in a 20 WPC fetus. In a 23 WPC fetus (0.6%) the two testes were absent. Epididymal disjunction anomalies were found in four fetuses (2.4%). *Conclusions:* The urogenital anomalies in human male fetuses are rare and have an incidence around 4%.

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Keywords: Urogenital anomalies; Human fetuses; Kidney; Testis; Anorchism; Horseshoe kidney

1. Introduction

The genital and urinary systems have the same embryological origin from the intermediate mesoderm along the posterior wall of the abdominal cavity [1]. Initially the excretory ducts of both systems reach the same cavity called cloaca. The genital and

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urinary systems begin their growth around the fourth week post conception and finish it at the twelfth week post conception [1,2].

The most common congenital malformations anomalies are, according to their incidence, skeletal muscle, cutaneous and urogenital [3]. The most frequent genitourinary anomalies are renal, testicular and urethral, respectively [1,2]. About 10% of the population has some kind of genital or urinary system anomaly [4].

Since the advent of antenatal ultrasound screening, many congenital anomalies have been evaluated during the prenatal period [5]. The early diagnosis of those anomalies is very important for the child's follow up after birth [6]. There are many studies in the literature that use antenatal ultrasound during the prenatal period to evaluate the incidence of congenital genitourinary malformations [5–7].

The study of the incidence of urogenital anomalies in children and in patients that have some syndromes such as cystic fibrosis, chromosomal anomalies and neoplasm are very frequent [8,9]. However, there are few studies in the literature performed in human fetuses evaluating the incidence of genitourinary anomalies [10].

The objective of this study is to analyze the incidence of congenital urogenital malformations in human male fetuses.

2. Methods

We studied 166 fresh human male fetuses that died of causes unrelated to the urogenital tract, between January 1996 and December 2002. The fetuses were macroscopically well preserved and no external evidence of congenital malformations was detected. The gestational age was determined in weeks post conception (WPC), according to the foot length criteria. Nowadays this is the most acceptable method to estimate the fetal age [11–13].

After the measurements, the abdomen and pelvis were opened to identify and expose the urogenital organs. The fetuses were dissected with the aid of a stereoscopic lens with $2.5 \times$ magnification.

We studied the incidence of renal, ureteral, vesicle, urethral, testicular, epididymal, vas deferens, prostate and penile anomalies. The renal anomalies were divided in rotation,

Table 1
Relation between the number of fetuses studied and their age in weeks post conception (WPC)

Age (WPC)	Fetuses (%)
10–12	4 (2.4%)
13–15	30 (18%)
16–18	27 (16.2%)
19–21	34 (20.4%)
22–24	30 (18%)
25–27	19 (11.4%)
28–30	16 (9.6%)
31–33	5 (3%)
34–36	1 (0.6%)
Total	166 (100%)

Table 2

Relation among the anomaly, the gestational age in weeks post conception (WPC) according to the foot length criterion, and the side affected

Anomaly	Age	Side
Horseshoe kidney	20 WPC	–
Renal agenesis	25 WPC	Left
Anorchia	23 WPC	Bilateral
Vas deferens agenesis	23WPC	Bilateral
Epididymis tail	24 WPC	Left
Epididymis tail	29 WPC	Right
Epididymis tail	35 WPC	Left
Epididymis head	28 WPC	Right

All epididymal anomalies found were disjunctions. The agenesis of the vas deferens was found in the same fetus with anorchia.

fusion, number and ascension [1,2]. We observed the presence of vesicle and ureteral duplication, vesicle septation, hypospadias and posterior urethral valve [1,2]. The testicular anomalies were divided in number and position [14]. The epididymal anomalies were divided in obliteration, disjunction, number and ectopy [15]. The vas deferens anomalies were divided in obliteration and number [15].

This study was approved by the institutional review board at our institution.

3. Results

Fetuses' age were ranged from 10 to 35 WPC (corresponding from 12 to 37 postmenstrual weeks). Table 1 shows the relation between the number of fetuses that were studied and their age in weeks post conception. Of the 166 fetuses, 7 (4.2%) presented some kind of anomaly of the urogenital system. Table 2 shows the relation among the anomaly, the side affected and the fetus' age.

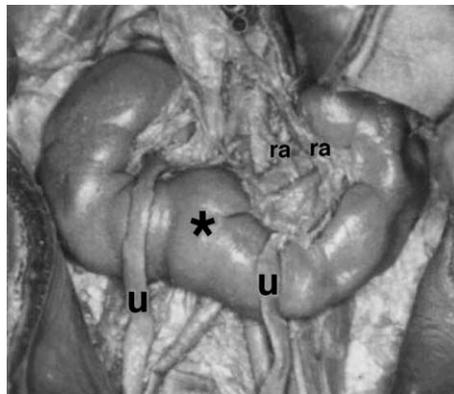


Fig. 1. A 20 WPC fetus showing a horseshoe kidney. u = ureter; ra = renal arteries; * = isthmus.

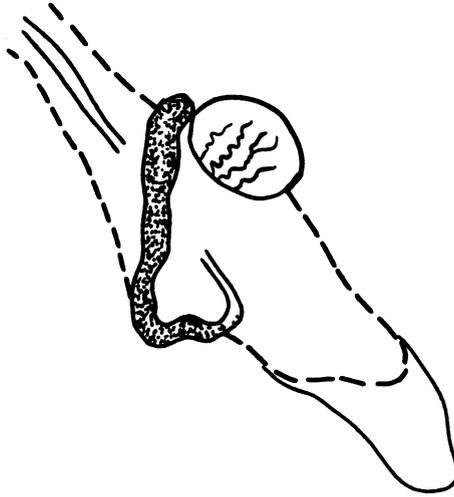


Fig. 2. Schematic drawing showing disjunction of the epididymis tail.

Renal anomalies were found in two fetuses (1.2%). Unilateral renal agenesis was found in a 25 WPC fetus. Horseshoe kidney was found in a 20 WPC fetus (Fig. 1).

In a 23 WPC fetus the two testes were absent and the epididymis, the vas deferens, the seminal vesicles and the gubernaculum were not visualized. However, the penis, the prostate and the scrotum were well individualized.

Epididymal disjunction anomalies were found in four fetuses (2.4%). In three of these cases, in fetuses of 24, 29 and 35 WPC, we visualized disjunction anomalies of the epididymis tail (Fig. 2); and in a 28 WPC fetus we found a disjunction anomaly of the epididymis head (Fig. 3).

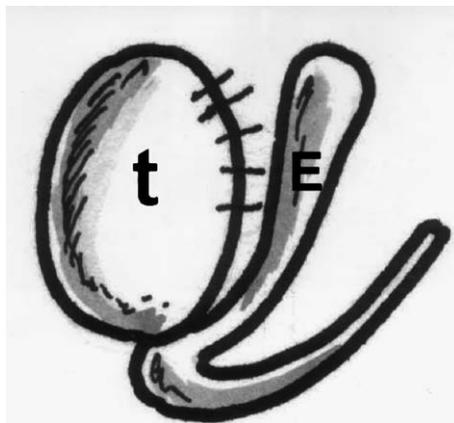


Fig. 3. Schematic drawing showing disjunction of the epididymis head. T=Testis; E=Epididymis.

4. Discussion

The anomalies of the urinary tract are frequent and correspond to 1/3 of all congenital malformations [1–3,5]. The renal agenesis is one of the most frequent renal anomalies and has an incidence of between 1/200 and 1/4000 births [16]. The renal agenesis is more common in men and happens on the left side [1,2]. We found 1 of 166 male fetuses (0.6%) with renal agenesis on the left side.

The most frequent fusion renal anomalies are the horseshoe kidney and the crossed fused renal ectopia. The horseshoe kidney presents an incidence of between 1/400 and 1/1000 births [17] and is more frequent in men. Among the 166 fetus that we analyzed, we found only one case (0.6%) of fusion renal anomaly in a 25 WPC fetus with a horseshoe kidney.

The rate of anorchia is about 3–10% of cryptorchidism cases [15]. The absent testis is also called vanished (or vanishing testis). Bilateral anorchia is a very rare condition, occurring in approximately 1/2000 births [18]. We found bilateral anorchia in one fetus.

There are three theories to explain congenital absence of the testis: (a) Absence of testicular development during fetal period; (b) Discontinuation of vascular supply to the testes during fetal period; and (c) Atrophy caused by intrauterus testicular torsion [14]. Discontinuation of testicular vascularization during fetal period would occur by extravaginal torsion (spermatic chord torsion), that would be the most frequent mechanism involved in testicular agenesis [18].

The fetus with bilateral anorchia presented a male phenotype (penis and scrotum). The bilateral anorchia with male phenotype is explained according to the period when the fetal testicle disappears (probably by torsion) [15,18]. When the testes disappear after the sixteenth week of development, the penis and the scrotum are normally formed [15]. The anorchia with male phenotype indicates that the testes were present until the sixteenth week of development and then disappeared. Testicular vestiges that could be histologically analyzed had not been found in this fetus. As well, we did not find any signal neither of the epididymis nor the vas deferens. The agenesis of vas deferens coexists with anomalies of other organs derived from the paramesonephric ductus with a certain frequency [8].

The epididymis, vas deferens, seminal vesicle and ejaculatory ducts have their origin from the mesonephric duct [1,2,14,15]. The development of this ductal system ends around the thirteenth WPC [1,2]. The anomalies of this anatomical structures are also prevalent in patients with infertility, and frequent occurs in patients with cryptorchidism and cystic fibrosis [8,19].

The epididymal anomalies are frequently associated to cryptorchidism—36% to 79% of the cases [14,19]—and infertility in adults [8,14]. There are many studies performed in patients with cryptorchidism and infertility that show the incidence of epididymal anomalies in these pathologies [8,14,19].

Turek [20] in a study with normal children showed that the epididymal anomalies were present in 4% of the cases. In a previous study with 73 human fetuses with no congenital anomalies we showed that the epididymal anomalies were presented in 2.75% of the cases [10]. In this study we found four fetuses (2.4%) with epididymal disjunction: one in the head and three in the tail. The sample of this study [10] (73 fetuses with the

four cases of epididymal anomalies) was used in the present study and this sample was substantially increased in more 93 fetuses, having totalized the 166 fetuses that we are analyzing.

The vas deferens anomalies are responsible for 1–2% of the infertility cases in men, and are associated with 65–95% of the cases of cystic fibrosis [8,14,19]. The vas deferens anomalies appear to be a congenital anomaly associated with cystic fibrosis [15]. There appears to be little doubt that the atrophy of the vas in cystic fibrosis is truly congenital and is not acquired in the post-natal period [8,9,14]. There are few studies about the anomalies of the vas deferens. And we found bilateral agenesis of the vas deferens in one fetus.

The most frequent anomalies of the urethra is hypospadias, and has an incidence of between 1/122 and 1/250 male births [21]. Among the 166 fetus that we analyzed the urethra with the aid of a stereoscopic lens with $2.5 \times$ magnification, we do not found any anomaly of the urethra.

We concluded that the urogenital anomalies in human male fetuses are rare and have an incidence under 5%. In this study we found only one case (0.6%) of bilateral anorchia, a severe urogenital anomaly that causes damage of the body function.

Acknowledgements

Supported by grants from the Foundation for Research Support of Rio de Janeiro (FAPERJ) and Council of Scientific and Technological Development (CNPQ).

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