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Prenatal measurement of testicular diameter by ultrasonography: development of fetal male gender and evaluation of testicular descent

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Prenatal ultrasonography has evolved through advancements in imaging technology and observer experience. The purpose of the present study was to evaluate fetal testicular descent and diameter in relation to gestational age. A prospective cross-sectional study on 331 fetuses from an unselected population underwent a detailed assessment of testicular descent and diameter at 20–40 weeks' gestation by means of transabdominal sonography (91.2%) and transvaginal sonography (8.8%) when necessary. Fetal gender was identified in the transverse and sagittal planes and maximum testicular diameter was measured. The mean testicular diameter (in millimeters) per week and the 95% confidence interval (CI) were defined. Testicular descent was not observed prior to 23 weeks' gestation, with 6.6% of the fetuses having one testis descended at 23 weeks and 98.2% after 32 weeks. A linear relationship between testicular diameter and gestational age was observed. The present results chart the time course for testicular descent and provide a centile chart for fetal testicular diameter from 25 to 40 weeks' gestation. These findings may aid prenatal diagnosis of associated abnormal conditions as well as investigations into the clinical finding of abnormal testicular size.

KEY WORDS: testicular diameter; ultrasonography; prenatal diagnosis; cryptorchidism

INTRODUCTION

Testicular descent into the scrotum is dependent upon a series of complex endocrine and mechanical interactions (Achiron *et al.*, 1998a). Even if the finding of undescended testes in late gestation may be observed in a normal fetus, it could also be associated with a potential risk for perinatal problems ranging from severe multiple congenital abnormalities to incorrect sex assignment due to masculinization of female genitalia (Benacerraf and Bromley, 1998). The incidence of cryptorchidism at 1 year of age is 0.8%, and few testes spontaneously descend with age (Elder, 1987). Cryptorchidism may be associated with a variety of congenital syndromes, due to either chromosomal aberration or monogenic disease (Foresta *et al.*, 1999). A genetic etiology for cryptorchidism is also suggested by the observation of a familial occurrence in some cases (Czeizel *et al.*, 1981).

Although the diagnosis of fetal gender has been widely reported, biometric data in the literature on normal development of the fetal testis are scarce (Achiron *et al.*, 1998a; Birnholz, 1983).

The goal of the present study was to construct centile nomograms for testicular size during normal gestation, as well as to determining the timing of testicular descent.

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SUBJECTS AND METHODS

A cross-sectional prospective study was performed at the Artemisia Medical Center to evaluate the gestational period of testicular descent as well as to construct a centile chart of fetal testicular size. The study group consisted of 331 singleton pregnancies with a proven gestational age assessed by ultrasonographic examination in the first or early second trimester. All fetuses fulfilled the following criteria: (1) absence of ultrasound detectable congenital abnormalities and (2) absence of maternal disease and a clinically normal fetus at term.

Exclusion criteria were multiple pregnancies, unknown date of the first day of the last normal menstrual cycle, and maternal or fetal conditions requiring hospitalization or intervention.

The ultrasonographic examinations were performed by means of commercially available ultrasound equipment (Ansaldo Esaote Hitachi Astro, Genoa, Italy). Ultrasound scans were performed with a 3.5 MHz convex probe in 302 patients and with a 6.5–7.5 MHz transvaginal transducer in 29 patients (91.2% and 8.8%, respectively).

Testicular diameters and evaluation of descent were obtained during routine ultrasound examination performed mainly to rule out anomalies in addition to during routine third-trimester evaluation. Each patient was examined only once during this study and all measurements were made by a single observer (C.G.).

Within 5 days postpartum, in order to confirm the

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Figure 1—Perineal view of testicular descent and measurement of testicular diameter (TD = 12.7 mm) at 33 weeks' gestation

sonographic findings, all newborns underwent physical examination of the testis performed by a neonatologist.

Testicular maximum diameter was measured in millimeters by means of an electronic tracing taken in the longitudinal axis of the testicle (Figure 1). Every measurement was repeated twice for each testes in each fetus and the mean value was determined. Data were collected on data forms and entered into a database. Mean fetal testicular diameter with 5th and 95th confidence intervals (CI) for each week were calculated. Statistical analysis was performed with SPSS-PC (SPSS Inc., Chicago, IL, USA).

RESULTS

Testicular descent was studied in 331 fetuses between 20 and 40 week's gestation. The earliest observation of a descended testis was found at 23 weeks even if in a low percentage (6.6%) of cases. As shown in Table I this percentage progressively increased with increasing gestational age reaching 100% of successful bilateral testicular descent at 31 weeks. After 32 gestational weeks only 2/112 fetuses (1.8%) still showed undescended testis.

All prenatal results were confirmed by postnatal examination; there were no cases of false-negative or false-positive diagnosis.

Measurements of testicular diameter were obtained in 248 fetuses between 23 and 40 weeks' gestation. Mean, 5th and 95th CI (in millimeters) testicular diameters by gestational age are shown in Table I. The inter-observer variability was not calculated, since only one observer performed the study; the intra-observer repeatability of the measurements was 9.6%. The individual scatter plot (Figure 2) showed a linear relationship between testicular diameter vs gestational age with the following regression equation:

$$y = -15.239 + 0.87x + \varepsilon$$

where y represents the fetal testicular diameter (in millimeters), x the gestational age and ε the random error associated with measurement. The correlation between the two variables ($r = 0.93$) was statistically significant ($p < 0.001$).

DISCUSSION

Determination of male external genitalia can be detected sonographically from the 14th week of gestation (Emerson *et al.*, 1997), while testicular descent into the scrotum, even if variable, has never been reported before the 23rd week. For this reason, we measured testicular maximum diameter after descent into the scrotum around 23 weeks in order to establish a nomogram during prenatal life. Recently published papers have reported a strong correlation between several ultrasound measured fetal parameters and gestational age (Achiron *et al.*, 1998a,b). Therefore, the strong correlation ($p < 0.001$) between testicular size and gestational age reported in the present study can not be considered unexpected. Nevertheless, since no data about testicular size in prenatal life are available, it may be useful to construct a centile nomogram. In fact, even if the clinical significance of micro or macro-orchidism in fetal life is still unknown, it is clear that any screening program that might evaluate such conditions will be possible only if nomograms for *in utero* ultrasonographic measurements of testicular size have been previously established.

Testicular descent according to gestational age was also examined in the present study. The results compare favorably with previous studies (Birnholz, 1983; Achiron *et al.*, 1998a) which showed no descent occurring prior to 24 weeks' gestation. Only three fetuses presented with testicular descent before 25 weeks in the present series. Beyond 32 weeks' gestation over 98% of the fetuses had both testes in the scrotum. These ultrasonographic results are in agreement with earlier findings on the incidence of testicular descent at birth (Scorer, 1956; Elder, 1987). The sonographic appearance of normal fetal genitalia could be helpful in prenatal identification of several clinical situations that include ambiguous genitalia, hypospadias, anorchidism and cryptorchidism, which are the most frequent anomalies of the external genitalia with an incidence of 3.4% in the term newborn, and 0.8–1% at 1 year of age (Elder, 1987; Desgrandchamps, 1990; McAlister and Sisler, 1990; Hutson *et al.*, 1997). Testicular maldescent occurs bilaterally in 10–15% of cases, and both the bilateral and unilateral condition are known to be associated with increased risk of malignancy and altered spermatogenesis, which may lead to infertility, (Kogan, 1987; Lee, 1993). The pathogenesis of these two sequelae remains unclear, since they might be due to an underlying intrinsic

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