DEVELOPMENT OF THE SEMINIFEROUS TUBULES AND RETE TESTIS DURING PRENATAL HUMAN DEVELOPMENT

O. I. Brindak, V. A. Vlasov, and V. A. Malishevskaya

UDC 611.631-013

The source of origin and particular features of the formation of the seminiferous tubules and tubules of the rete testis during prenatal human development were studied. The seminiferous tubules and tubules of the rete testis were shown to be formed from bands of cells of the celomic epithelium and primordial germ cells, which appear simultaneously in the anlage of the mediastinum testis and the central part of its parenchyma in embryos 13.0-17.0 mm long. It was shown by methods of plastic and graphic reconstruction and fine dissection under the control of the MBS-1 binocular microscope that the seminiferous tubules anastomose with each other both in the same and in adjacent lobules. Tubules of the rete testis do not form anastomoses but are superposed one above the other to give the impression of a network. They merge as they approach the tunica albuginea and continue into the efferent ductules.

KEY WORDS: seminiferous tubules; tubules of the rete testis.

The morphogenesis of the male gonad and, in particular, of its internal structures has not yet been adequately studied and further research is necessary for both clarification and interpretation.

The object of this investigation was to study the development of the seminiferous tubules and the rete testis during human prenatal development.

EXPERIMENTAL METHOD

The test material consisted of 110 series of histological preparations of human embryos (starting from 3 weeks, length 3 mm), prefetuses, fetuses, and newborn infants, and also 15 macroscopic specimens of testes from fetuses in the late stages of development and of newborn infants. The preparations were stained with hematoxylin–eosin or with borocarmine by the usual methods, and methods of plastic and graphic reconstruction [5] and fine dissection under the control of the MBS-1 binocular microscope also were used.

EXPERIMENTAL RESULTS

The primordial anlage of the gonad first appears at the end of the 3rd or beginning of the 4th week of embryonic development (length of the embryo 3-4 mm) as a ridge on the ventromedial surface of the mesonephros running along its whole length. It is formed by a collection of mesenchymal cells, covered on the side facing the celomic cavity by two or three rows of cells of celomic epithelium, among which can be seen solitary large primary germ cells. At the 5th-6th week of embryonic life (embryos 5-13 mm long) cells of the celomic epithelium and primary germ cells migrate into the subjacent mesenchyme of the genital ridge. In embryos 7-10 mm long the anlage of the future mediastinum testis appears. After the appearance of the independent mediastinum testis, the gonad begins to be separated from the mesonephros by longitudinal fissures above and below it, and it becomes ovoid in shape.

Differentiation of the undifferentiated gonad toward the male type begins in embryos at the end of the 6th or beginning of the 7th week (length 13-17 mm). Under these circumstances bands of cells of the celomic epithelium and primary germ cells appear simultaneously in the anlage of the mediastinum and central part

Department of Human Anatomy, Chernovtsy Medical Institute. (Presented by Academician of the Academy of Medical Sciences of the USSR A. P. Avtsyn.) Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 85, No. 2, pp. 227-229, February, 1978. Original article submitted June 22, 1977.

0007-4888/78/8502-0233$07.50

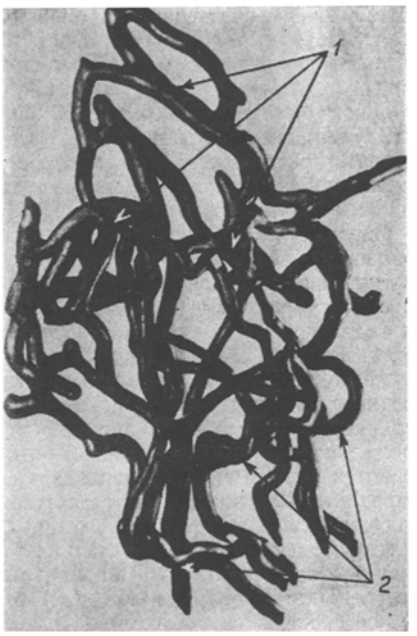

Fig. 1. Plastic reconstruction of seminiferous tubules of lobule of testis and corresponding part of rete testis from a human fetus with crown to rump length of 270.0 mm; 91×. 1) Seminiferous tubules; 2) tubules of rete testis.

of the parenchyma of the testis. The longitudinal dimensions of the bands of parenchyma of the gland (genital cords) vary from 20 to 40 μ and their transverse from 6 to 8 μ. The cords of the mediastinum testis are much smaller and vary from 10 to 20 and from 2 to 4 μ respectively.

The genital cords of prefetuses aged 8-10 weeks (crown to rump length 30-55 mm), because of intensified growth, become curved, especially in their peripheral parts. In the central part the number of primary germ cells is increased. Around the genital cords appears the anlage of the tunica, which consists of circularly oriented mesenchymal cells with long nuclei and delicate connective-tissue fibers.

The cords of the mediastinum testis consist mainly of cells of celomic epithelium together with solitary primary germ cells. The structure of their membrane is similar to that of the genital cords.

Septa, beginning to divide the organ into lobules, run from the tunica albuginea into the parenchyma of the gland.

In 12-16-week fetuses (crown to rump length 77-130 mm) the curvature of the genital cords and cords of the mediastinum testis is increased, but they are indistinguishable in structure from the prefetuses of the group described above. In many areas the peripheral parts of the genital cords are divided into two, and in some places the adjacent genital cords unite.

Canalization of the genital cords begins from the periphery of the gland in 16- to 20-week fetuses (crown to rump length 135-185 mm) and continues toward the mediastinum testis. In the central part of the peripheral portions of the cords a lumen measuring 2-4 μ in diameter now appears. By this age period the cords are more winding still, and they connect with one another to form arches. From the time of appearance of the lumen in the genital cords they can be called seminiferous tubules.

The cords of the mediastinum testis in fetuses of this age period have no lumen. They consist of cells of the celomic epithelium, but in some cords solitary primary germ cells can be seen. The membrane of the cords of the mediastinum testis is better developed than that described in the previous age group. It consists of one or two rows of elongated cells with circular orientation and of connective-tissue fibers.

As the fetus grows, the number of anastomoses between adjacent seminiferous tubules increases both within the lobule and outside it. By joining together the seminiferous tubules form arches, superposed one above

the other in arcade fashion, and at birth five to seven rows of these arches can be counted. As the mediastinum testis is approached, two or three adjacent seminiferous tubules merge to form a straight tubule, which drains into a tubule of the rete testis.

Canalization of the cords of the mediastinum testis begins in fetuses at the 32nd-36th week of intrauterine development (crown to rump length 310-347 mm). The lumen of the tubules of the rete testis at birth is lined by simple cubical epithelium, and the wall is composed of connective-tissue fibers and two or three rows of elongated cells. The tubules of the rete testis form no anastomoses but, as they approach the mediastinal part of the tunica albuginea, they merge and continue into the efferent ductules. The impression of the rete testis is created as a result of superposition of the tubules one on the other, and not as a result of their anastomoses (Fig. 1).

Differentiation of the undifferentiated gonad toward the male type thus begins in embryos 13-17 mm long. Similar data on the time of commencement of differentiation of the gonad were obtained in other investigations [2-4, 6-8]. The workers cited stated that under these circumstances cords of cells appear in the central part of the parenchyma of the gonad, but they do not mention cords in the mediastinum testis. Nevertheless, cell cords appear simultaneously in the mediastinum and central part of the parenchyma of the testis and are formed by cells of the celomic epithelium and primary germ cells. The cords of the mediastinum testis are much smaller than the genital cords; that is evidently why other investigators have not noticed them. The general source of formation of the genital cords and the cords of the mediastinum testis obtained in the present investigation agree with results described by Roosen-Runge [9], who showed that the intratesticular part of the rete testis in rats develops from the genital cords, from which the primary germ cells gradually disappear. Our own observations also confirm Bresler's statement [1] that the epithelium of the tubules of the rete testis is the least differentiated derivative of the celomic epithelium in the testis.

The processes of formation of anastomoses between adjacent seminiferous tubules, both within the same lobule and outside it, traced in this investigation lead to the conclusion that the lobule of the testis is not a closed system, but adjacent lobules can communicate and their seminiferous tubules form a network.

By contrast with the generally accepted view, the results of this investigation indicate that the tubules of the rete testis do not form anastomoses but, by their superposition one above the other, the impression is strengthened even by the interweaving of the straight tubules, draining into the tubules of the rete testis, among them. As the mediastinal part of the tunica albuginea is approached, the adjacent tubules of the rete testis merge and continue into the efferent ductules, which themselves drain into the tubules of the epididymis.

LITERATURE CITED

1. V. M. Bresler, Cytological Mechanisms of Carcinogenesis in the Testis [in Russian], Moscow–Leningrad (1964).
2. S. E. Levina, Zh. Obshch. Biol., No. 3, 192 (1961).
3. S. E. Levina, Usp. Sovrem. Biol., 66, No. 3/6, 439 (1968).
4. S. E. Levina, Outlines of the Development of Sex in the Early Ontogeny of Higher Vertebrates [in Russian], Moscow (1974).
5. N. G. Turkevich, Reconstruction of Microscopic Objects from Histological Sections [in Russian], Moscow (1967).
6. W. Fialkowski, The Biological Rhythm of Fertility and Regulation of Conception [in Russian], Warsaw (1976).
7. J. L. Laurent, J. C. Cziba, and C. Cirod, Cah. Med. Lyon., 48, 4567 (1968).
8. L. J. Pelliniemi and M. Niemi, Z. Zellforsch., 99, 507 (1970).
9. E. C. Roosen-Runge, Acta Anat. (Basel), 45, 1 (1961).