A STUDY OF HUMAN FOETAL OVARY

by

BIMALENDU MUKERJEE,* M.S.

SHIVSHANKER DAYAL,** M.S., Ph.D.

and

RAJ BAVEJA,*** D.G.O., M.S., Ph.D.

Introduction

Development of the ovary during the intrauterine and neonatal life have been studied intensively. Multiplication of germ cells through stages of mitotic division (oogonia) and later meiotic prophase (oocyte) have been described by Pinkerton *et al* (1961) Gondos *et al* (1971) Pryse-Davies *et al* (1971). For long it was believed that the surface epithelium gives rise to granulosa cells (Brambell, 1927; Everet, 1943 and Franchi *et al*, 1962); but later Peters and Pedersen (1967) put forward the view that the granulosa cells originate from the stromal cells. In foetal mouse ovary some of the cells attached to oogonia before mitosis starts have been thought to be future granulosa cells (Oor and Blandau, 1969). There is another belief that the cell cords present in the developing ovary contribute to the formation of granulosa cells. These cords have variously been termed 'cordons medullarie' by Waldeyer (1870), "Markstrange" by Kolliker (1898) and 'Medullary cords' by Kingsbury (1913-14). The recent view of Byskov (1975) suggests that in the cat, mink and ferret there may be a dual origin of granulosa cells from rete ovarii and from ovarian surface epithelium. So far the entire study on ovary is based mostly on animal material. The present study was designed to reexamine the ovarian development in the human foetal ovary.

Material and Methods

The study comprised of 36 human female foetuses from 6 week (17 mm. C.R. length) to 36 week (324 cm. C.R. length). Twenty-seven foetuses were taken from normal therapeutic abortion (6-27 weeks gestation) and 8 from still-births (28-36 weeks gestation). Ovaries of the foetuses of 6 and 7 weeks were sectioned as whole foetus whereas in the other cases ovaries were removed by laparotomy and were processed for histological studies. The paraffin section at 7 μ thickness were cut serially in transverse and longitudinal planes and stained with H and E.

Results

The gonad at 6 weeks (17 mm C.R. length) consisted mainly of mesenchymal cells. The cells at the surface of the gonad were in the process of epithelisation. Some germ cells were scattered in the mesenchymatous mass of cells. The

*Lecturer in Anatomy.

**Professor of Anatomy.

***Professor and head of the department of Obstetrics and Gynaecology.

M.L.N. Medical College, Allahabad.

Dr. B. Mukerjee—For reprints.

Accepted for publication on 7-2-79.

nuclei of the germ cells were in various stages of mitosis. At 7 weeks (23 mm C.R. length) some of the germ cells (oogonia) were surrounded by a few mesenchymatous stromal cells (Fig. 1). This feature was the earliest sign of analage of a primary follicle. By 8 weeks (32 mm C.R. length) the surface epithelium is fully formed and there is an uninterrupted single layered cuboidal epithelium. At 10 weeks (41 mm C.R. length) it was observed that cellular cords of stromal cells form a network in the central region of the ovary. These cords were in continuity with follicular cells surrounding the oogonia (Fig. 2). By 16 weeks (113 mm C.R. length) there was an appreciable increase in the number of primordial follicles. The follicles were numerous midway between the hilum and the surface of the ovary. The germ cells of many of the follicles showed stages of early meiosis. At 19 weeks (155 mm C.R. length) the medulla and the cortex were separately distinguishable. The cortical region was thicker than medulla and it was divisible into an outer and inner zone. The outer zone was packed with stromal cells only, whereas the inner zone contained many primordial follicles. The medullary stromal cells were sparsely arranged and the whole medulla was traversed by many blood vessels; some of the follicles showed degenerated oocytes (Fig. 3) but the granulosa layer of these follicles was not distorted.

By 25 weeks (210 mm C.R. length) the vascularity increased markedly but, even at this stage the outer cortex and the poles of the ovary had very scanty blood supply. In those regions of the ovary where the granulosa layer of the primordial follicles were fully formed the network of cellular cords are no more found.

At 32 weeks (280 mm C.R. length) large primordial follicles showed perivitelline space (Fig. 4). At 36 weeks (324 mm C.R. length) the outer cortex of the ovary was still packed with stromal cells and remained poorly vascularised. The inner cortex, amongst many primordial follicles, showed a few Graafian follicles with large oocyte surrounded in cumulus ovaricus. The thick stratum granulosum surrounded a large follicular cavity. The stromal cells around the Graafian follicles were organised to form a thick theca folliculi (Fig. 5).

Discussion

The present study has revealed that the surface epithelium and the follicular epithelium (granulosa layer) both are derived from the same source that is, mesenchymal cells which gives rise to stroma. The process of surface epithelisation is complete by 8 weeks but the granulosa formation is a continous process throughout the follicular period of development. The contribution of surface epithelium in the formation of granulosa layer or the dual origin of the follicles as suggested by Byskov (1977) could not be agreed upon by us because, our observations show that the entire population of follicles are formed in the deeper cortex which is away from the surface layer. However, granulosa cells bear a link with the cellular cords which according to Kingsbury (1913-14) are medullary cords and as these cords form a network, Byskov and Moore (1973) have termed them intraovarian rete. The earliest primordial follicles seen at 7 weeks consist mainly of oogonia. The follicles containing large oocytes appear as late as 16 weeks. The transformation of oogonia to oocyte begins slowly at first and then at a much faster rate. Atresia affecting the oocyte

of the developing follicle is commonly seen in the later part of foetal life. According to Ingram (1962) process of atresia begins early in the development and continues into the follicular stages as follicular atresia. The cause of atresia of large number of follicles can be attributed to poor blood supply of ovary, especially at the more peripheral regions.

References

1. Brambell, F. W. R.: Proceedings of the Royal Society. **101:** 391, 1927.
2. Byskov, A. G. and Moore, S. L.: J. Anat. **116:** 207, 1973.
3. Byskov, A. G.: J. Reproduction and Fertility. **45:** 201, 1975.
4. Byskov, A. G., Skakkebak, N. E., Stafanger, G. and Peters, H.: J. Anat. **123:** 77, 1977.
5. Everet, N. B.: J. of experimental Zoology. **92:** 49, 1943.
6. Franchi, L. L., Mandl, A. M. and Zuckerman, S.: The ovary Vol. 1st. Ed. S. Zuckerman, New York and London: Academic Press, 1962, Ch. I.
7. Gondos, B., Bhiraleus, P. and Hobel, C. J.: Am. J. Obstet. Gynec. **110:** 644, 1971.
8. Ingram, D. L.: The ovary, Vol. 1st Ed. S. Zuckerman. New York and London, Academic Press, 1962, Ch. 4.
9. Kingsbury, B. F.: Am. J. Anat. 15: 345, 1913-14.
10. Kolliker, A.: Uber die Markkanale und Markstrange in den Dierstocken junger Hundinnen. Verhandlungen der anatomischen Gesellschaft. **14:** 149, 1898.
11. Odor, D. L. and Blandau, R. J.: Am. J. Anat. **124:** 163, 1969.
12. Peters, H. and Pedersen, T.: Fertil. Steril. **18:** 309, 1967.
13. Pinkerton, J. H. M., Mackay, D. G., Admms, E. C. and Hertig, A. T.: Obstet. Gynec. **18:** 152, 1961.
14. Pryse-Davies, J. and Dewhurst, C. J.: J. Path. **103:** 5, 1971.
15. Waldeyer, W.: Eierstock Und Ei. Leipzig. Engelmann, 1870.

See Figs. on Art Paper III-IV