HISTOCHEMICAL STUDY OF CELLS WITH FOAMY CYTOPLASM IN THE HUMAN OVARIES AT TERM*

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The human ovary at term shows many cells with foamy cytoplasm.[1] Nothing is known about their origin and histochemical nature. It is also not known whether the function of these cells is storage or secretion. The present study, using histochemical techniques, describes the histochemical nature and origin of these cells, comparing them with the other ovarian gland cells (interstitial gland cells, theca lutein gland cells and granulosa lutein gland cells) studied histochemically at the end of pregnancy.[2,3] These comparisons may throw further light on the morphological and functional significance of different gland cells in the human ovaries at term, which are exposed to an unusual steroidal and gonadotrophic environment.[1]

MATERIAL AND METHODS

Human ovaries at term used in the previous investigations[2,3] were also studied for the present paper. Ovarian material from non-pregnant women, as described previously,[4,5] was also studied. Tissues were treated according to the histochemical techniques already reported.[2]

RESULTS

Ovaries at Term

Human ovaries at term showed many hypertrophied cells with foamy cytoplasm, which are distributed either in the ovarian stroma or at the periphery of some clear scars (Figs. 1 - 3). There were few of these cells in comparison with interstitial gland cells.[2] Their greatly-developed cytoplasm was filled with the coarse sudanophilic lipid inclusions which obscured the other cell organelles and nucleus (Fig. 3). (All 3 photomicrographs are frozen gelatin sections of human ovaries at term, fixed in formaldehyde calcium, postchromed in dichromate calcium and coloured in sudan black B.) The lipid bodies coloured intensely in sudan black B (Figs. 1 - 3). They stained pink in 1% nile blue sulphate and orange red in red sudan dyes, indicating the presence of some neutral fats (triglycerides). The lipid inclusions gave a positive reaction in the acid haematin technique which did not disappear completely in the control material fixed in weak Bouin solution and extracted with hot pyridine. This indicated a small amount of phospholipids in the lipid bodies which were also Schultz-positive. Cholesterol or cholesterol esters were also demonstrated. Most of the lipid inclusions were constituted by the pigments as they resisted fat solvents and paraffin embedding after fixations in Zenker, Bouin and Carnoy.

The lipid bodies were not dissolved completely in the material extracted with hot pyridine. The histochemical reactions showed that the lipid inclusion bodies of cells with foamy cytoplasm consisted of pigments, triglycerides, cholesterol or cholesterol esters and a small amount of phospholipids. The origin of cells with foamy cytoplasm could not be attributed to any component of the ovaries at term.

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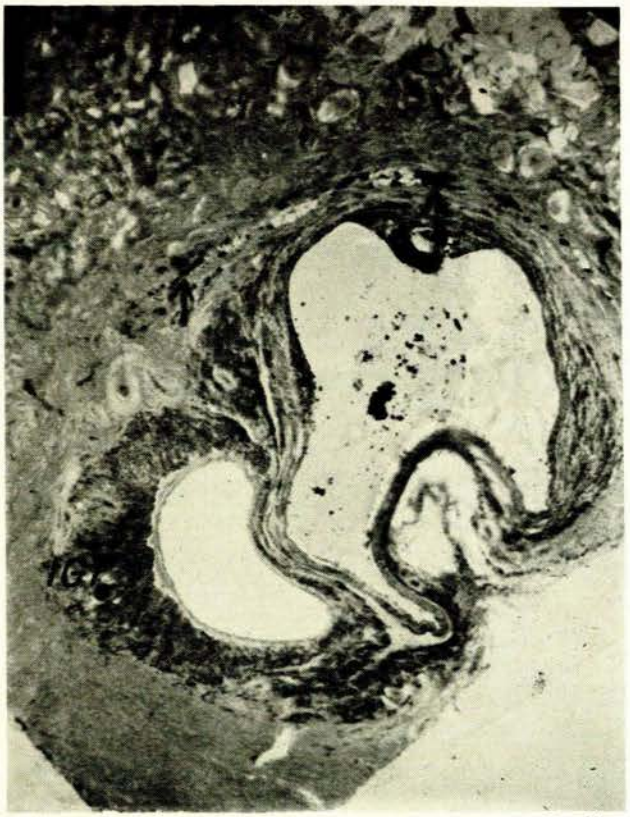

Fig. 1. Part of ovary, showing sparsely scattered cells with foamy cytoplasm (arrows) which are filled with sudanophilic lipids. The interstitial gland tissue (IGT) is also seen around the degenerating follicles (× 40).

Ovaries of Non-Pregnant Women

In the ovaries of non-pregnant women, the corresponding cells with foamy cytoplasm were relatively small in size and were seen to be derived from the residual interstitial gland cells and theca lutein gland cells, as judged from their distribution in the peripheral portions of the degenerating follicles[4] and corpus albicans.[5] The histochemical nature of their lipid inclusions was the same as that described in the ovaries at term, but the corresponding cells of non-pregnant women were relatively much less hypertrophied.

DISCUSSION

The different gland cells of internal secretion, which include the interstitial gland cells, theca lutein gland cells and granulosa lutein gland cells, show considerable hypertrophy and development in the human ovaries at term.[2,3] They are present in varying proportions and the most striking cytological features of their greatly developed cytoplasm are as follows: (*i*) The lack of accumulations of sudanophilic steroidal lipids; (*ii*) the presence of well-developed cell organelles such as the Golgi apparatus and mitochondria; and (*iii*) the presence of diffuse lipoproteins

throughout the cytoplasm, which are thought to be derived from the abundant agranular endoplasmic reticulum seen in electron-microscope studies.

The well-marked cytological differentiation and the absence of sterol granules in their cytoplasm have been attributed to some strong gonadotrophic stimulation present in pregnancy. The high levels of gonadotrophins are now known to cause the mobilization of steroidal lipids from the ovarian gland cells of a variety of mammalian species.[6-10] The cytological and histochemical features of interstitial gland cells, theca lutein gland cells and granulosa lutein gland cells in the human ovaries at term suggested that their function must be the secretion of steroid hormone rather than the storage of hormone precursor (steroidal lipids). Gonadotrophins have been shown to be capable of stimulating *in vitro* steroidogenesis in the various compartments of the human ovary.[11]

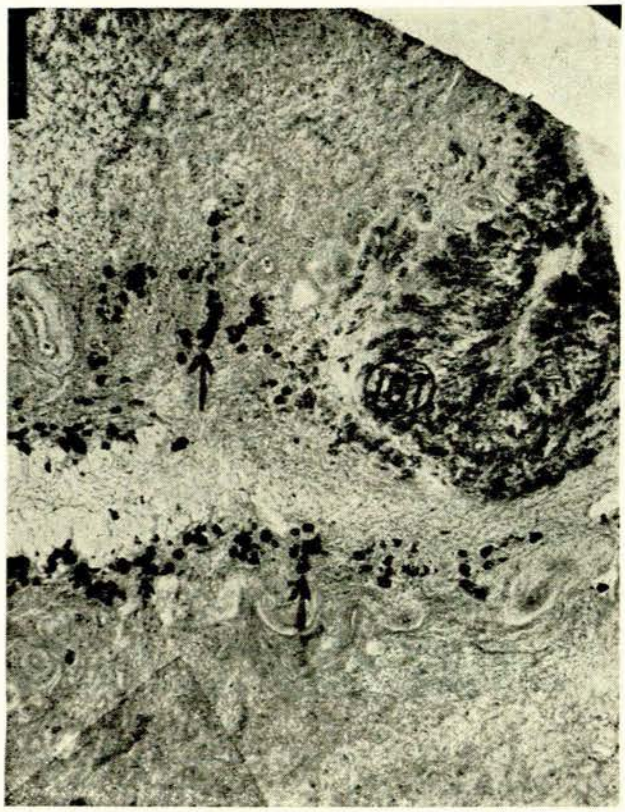

Fig. 2. Part of ovary, showing cells with foamy cytoplasm (arrows) which are filled with sudanophilic lipids. The interstitial gland tissue (IGT) is also seen (× 40).

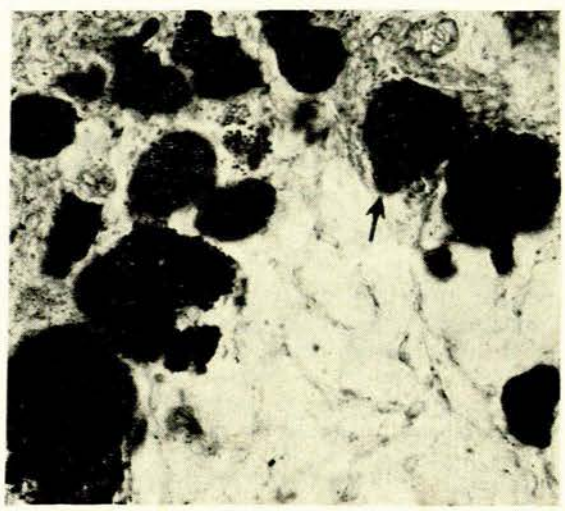

Fig. 3. Higher power view of cells with foamy cytoplasm (arrow), showing accumulation of sudanophilic lipids (× 165).

In the different gland cells of the human ovary, the active steroidogenesis through a stimulation by gonadotrophin occurs only when there is no storage of steroidal lipids demonstrable with histochemical techniques. The cells with foamy cytoplasm described in this article are filled with sudanophilic lipid secretory products which consist of pigments, triglycerides, cholesterol or cholesterol ester and some phospholipids. The storage of these steroidal lipids clearly indicates that the cells with foamy cytoplasm have become refractory to stimulation by the gonadotrophic substance *in vivo*, which is apparently responsible for the absence of steroidal lipids in other gland cell species discussed above.[2,3]

Similar gland cells, which are refractory to exogenous gonadotrophins, have also been described in the rabbit ovary,[7] in which they do not release their secretory lipid bodies after gonadotrophic stimulation. It appears that the whole of the cytoplasmic machinery in the cells of this study as well as of the rabbit ovary was so much altered owing to some senescent changes that they could not become active steroid secretors when abundant gonadotrophic substance was available. This strong gonadotrophic stimulation has simply prolonged the life of these cells with foamy cytoplasm in pregnancy, otherwise they would have degenerated and disappeared in the ovaries of non-pregnant women. Blanchette,[12] using an electron-microscope, has reported the details of senescent changes in the luteal cells of rabbit ovaries. They are filled with inclusion bodies of diverse nature; the smooth-surfaced endoplasmic reticulum is transformed into myeline and laminated inclusions during degeneration.

SUMMARY

Biopsies of ovaries from women at term have been studied with histochemical techniques. Besides the hypertrophied interstitial, theca lutein and granulosa lutein cells (which are active steroid secretors) described in the previous publications, many cells are seen with foamy cytoplasm filled with lipids consisting of pigments, triglycerides, cholesterol or cholesterol esters and some phospholipids. The accumulation of these lipids suggests that the cells with foamy cytoplasm are refractory to gonadotrophic substance available in abundance during pregnancy. These senescent cells are seen to be derived from the residual cells of interstitial gland tissue and theca lutein tissue in the ovaries of non-pregnant women. The morphologic-functional significance of different gland cells seen in the human ovaries at term has been discussed.

REFERENCES

1. Maqueo, M. and Goldzieher, J. W. (1966): Fertil. and Steril., **17**, 676.
2. Guraya, S. S. (1966): Amer. J. Obstet. Gynec., **96**, 907.
3. *Idem* (1968): *Ibid.*, **102**, 219.
4. *Idem* (1967): *Ibid.*, **98**, 99.
5. *Idem* (1968): *Ibid.*, **101**, 448.
6. *Idem* (1967): Nature (Lond.), **214**, 614.
7. *Idem* (1967): Z. Zellforsch., **83**, 187.
8. Guraya, S. S. and Greenwald, G. S. (1964): Amer. J. Anat., **114**, 495.
9. *Idem* (1964): Anat. Rec., **149**, 411.
10. *Idem* (1965): Amer. J. Anat., **116**, 257.
11. Savard, K., Marsh, J. M. and Rice, B. F. (1965): Recent Progr. Hormone Res., **21**, 285.
12. Blanchette, E. J. (1966): J. Cell Biol., **31**, 517.