CHAPTER V

CHANGES IN THE OVARY DURING LACTATION IN THE

RAT Rattus rattus rufescens (Gray)

Introduction

The quantitative studies of relation between ovum growth and follicular growth have been presented by Brambell (1928, 1935) and Burges (1931). Brambell alone has correlated the various morphological types of follicles in the mouse with corresponding ovum stages in oogenesis. In spontaneously ovulating mammals, the oestrus cycle is marked not by follicle rupture and corpus luteum formation, but also cyclical changes in the rate of ovogenesis (Allen, 1922, Evans and Swezy, 1931). The lactation stage of reproduction alter the hormonal activity of the ovary and pituitary in mammals. Perhaps most striking effect of lactation is delay in implantation occurs when the animal is both pregnant and lactating.

The present study has the first aim to correlate histological changes in the ovary of the lactating rat with regard to (a) follicles and ovum growth and (b) fate of the corpora lutea during lactation.
Observations and Discussion

The structure of the ovary full term rat Rattus
rattus rattus rufescens shows typical character of pregnancy.
The number of corpora lutea of pregnancy vary from to 9
depending up on the conceptus in the uterus. The ovary
can be clearly differentiated into two distinct part (1) the
area having major corpora lutea of pregnancy while, 2) other
area bore various stages of follicular development. All
types of follicular development from primary to ripe
follicles for impending post-partum oestrus. The average
mean diameter of follicle is 624.00±8.91 μ (Table 10).

a) Size of the ovarian follicles

Table 10 and Fig 4.1 summarizes the measurement of
the ovarian follicles from full term, delivery and until
30 days of lactation. The ovarian follicles at full term
are significantly (P < 0.005) larger than the follicles of
various stages of lactation. At parturition, the follicles
are larger in size, preparing for post-partum oestrus, the
maximum size follicles measures 510 μ (Plate 6-0). Following
post-partum oestrus at 48 hrs and 15 days after lactation,
follicles measured 350 to 415 μ. In some stages of lacta-
ting rat follicles averaged 335 μ until 30 days but
after 13 days there was usually a definite variation in the
Fig. 41: Follicles, Corpora Lutea and Ovarian Size during Reproductive Stages of the Rat Rattus Rattus Rufescens (Gray).

- **Carpora Lutea**
- **Diameter of Follicles**
- **Diameter of Ovum**
<table>
<thead>
<tr>
<th>Lactation in hours and days</th>
<th>Total length of the animal (cm)</th>
<th>Standard length of the animal (cm)</th>
<th>Weight of the animal (g)</th>
<th>Diameter of corpora lutea (μ)</th>
<th>Diameter of follicles (μ)</th>
<th>Diameter of ovum (μ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full term</td>
<td>36.50±0.50</td>
<td>17.35±0.34</td>
<td>106.00±2.92</td>
<td>1620.00±7.57</td>
<td>624.00±6.91</td>
<td>67.00±0.93</td>
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<td>0</td>
<td>37.25±0.22</td>
<td>17.25±0.27</td>
<td>110.00±2.17</td>
<td>1550.00±22.07</td>
<td>510.00±19.55</td>
<td>55.00±0.82</td>
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<td>12</td>
<td>36.00±0.34</td>
<td>16.18±0.26</td>
<td>100.45±1.66</td>
<td>1359.00±43.33</td>
<td>578.00±10.68</td>
<td>56.00±0.65</td>
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<tr>
<td>24</td>
<td>37.90±0.18</td>
<td>18.25±0.27</td>
<td>102.25±1.88</td>
<td>1293.00±49.92</td>
<td>555.00±10.97</td>
<td>62.00±0.72</td>
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<tr>
<td>48</td>
<td>37.10±0.65</td>
<td>19.20±0.28</td>
<td>101.60±1.45</td>
<td>1313.00±14.89</td>
<td>565.00±19.78</td>
<td>61.00±0.45</td>
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<tr>
<td>54</td>
<td>36.50±0.89</td>
<td>17.90±0.29</td>
<td>92.80±4.65</td>
<td>863.00±91.99</td>
<td>350.00±15.57</td>
<td>54.00±1.43</td>
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<td>72</td>
<td>35.50±0.75</td>
<td>17.50±0.32</td>
<td>103.50±3.12</td>
<td>1099.00±26.38</td>
<td>417.00±15.54</td>
<td>68.00±1.35</td>
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<tr>
<td>4</td>
<td>37.50±0.19</td>
<td>18.30±0.28</td>
<td>104.00±2.50</td>
<td>999.00±18.80</td>
<td>369.00±21.95</td>
<td>52.00±2.05</td>
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<td>7</td>
<td>35.50±0.36</td>
<td>17.50±0.13</td>
<td>101.60±2.61</td>
<td>948.00±20.01</td>
<td>308.00±18.34</td>
<td>50.00±2.90</td>
</tr>
<tr>
<td>13</td>
<td>36.00±0.32</td>
<td>17.00±0.21</td>
<td>103.00±1.11</td>
<td>969.00±90.99</td>
<td>366.00±16.34</td>
<td>45.00±0.28</td>
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<tr>
<td>15</td>
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<td>18.90±0.25</td>
<td>101.90±3.38</td>
<td>865.00±48.02</td>
<td>384.00±10.57</td>
<td>70.00±1.05</td>
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<td>18.90±0.15</td>
<td>104.40±1.00</td>
<td>904.00±25.10</td>
<td>368.00±18.26</td>
<td>70.00±0.25</td>
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<td>30</td>
<td>37.00±0.10</td>
<td>18.00±0.25</td>
<td>100.00±1.05</td>
<td>760.00±42.45</td>
<td>335.00±19.52</td>
<td>58.00±1.16</td>
</tr>
</tbody>
</table>

*Significant difference between lactation stages 0.005.*
diameter of the follicles ranging from 365 to 384 μ. It is confirmed by vaginal smear the first oestrus occurs at 48 hrs followed by second in 15 and 17 day of lactation. This confirm the size of the preovulatory follicles 365 to 384 μ for the rat *Rattus rattus rufescens*.

The earliest oestrus occurs on 48 hrs of lactation. The follicles an average 365 on 15 and 17 day lactation 384 μ. The size of follicle and ovum attains the size of preovulatory condition, thereby indicating the onset of heat in most rat at 15 and 17 days of lactation.

**b) Growth of ovum**

The average size of ovum is plotted on graph (Fig. 4.1). The size of full term ovum measured 56 μ. Following parturition there is steady growth on size of ovum up to 48 hours lactation. At 48 hrs occurs the first oestrus in the lactating rat. The average size of ovum ovary measures 67 μ. After this stage up to 13 day of lactation ovum show slight variation in size of ovum ranged between 50 to 54 μ. The ovum in the ovary of lactating rat at their maximum size 70 μ were observed at 15th and 17th day of lactation.
c) The corpora lutea of lactation are found in every ovary of lactating ovary examined (Plate 4-0). The average number 5.543±0.0219 per ovary. At first day of lactation the corpora lutea of lactation 1293±19.92. There is slight decrease in the size of corpora lutea of lactation from parturition to 24 hours ranging from 1550±22.74 μ (zero hour) to 1293±19.92 μ (24 hrs). They decreased slightly in size until 15 days lactation. The corpora lutea of lactation at their maximum size after 15 days lactation 904 μ were still smaller than that of corpora lutea at time of parturition 1550 μ. The corpora lutea shrink at 30 day lactation. They measured 780 μ ± 12.45 μ and resemble inactive corpora lutea. The corpora lutea of lactation statistically highly significant P 0.005). Smaller than the corpora lutea of full term.

Significant changes occur in the ovarian structure in the ovary of lactating rat at 48 hrs and 15th and 17th day lactation (Fig. 4.1). By 15th day the corpora lutea of lactation are slightly smaller in size than early stages of lactation. The corpora lutea of zero hours after parturition remain constant in size measured 1550±22 μ. The corpora lutea of lactation are smaller than those of the pregnancy at time of parturition. Long and Evans (1922) agree with present observations. The corpora lutea of the
albino rat of the same size as the corpora lutea of pseudopregnancy (Wichert and Schurgast, 1942). They disagree with Long and Evans (1922) in that they find differences in size between the corpora lutea of ovulation, pregnancy and lactation.

In present studies the females were kept without males i.e., they are not mated at post-partum oestrus. As there is no further ovulation or oestrus until corpora lutea regress or cease to secrete progesterone, as that fresh follicles can mature. The persistence of corpora lutea during lactation in the rat is apparently due to output of prolactin associated with lactation.

In Rattus rattus rufescens the first oestrus observed at 48 hrs after parturition as indicated by vaginal cytological observations. Though, in the laboratory rat the matured follicles rupture with in 24 hrs after parturition and their ripening is accompanied by oestrus (Perry 1971). But in the hooping mouse Lontoma alexia, which ovulates spontaneously with in 48 hrs of lactation period is corroborated by the presence of oooytes in follopian tube (Breed, 1977).

Several lines of evidence indicate that substantial amount of progesterone are secreted during lactation stage in
the rat. This has been directly by chemical determination of progesterone in ovarian venous blood. The amount of progesterone in the blood is influenced by the size of the litter size, more progesterone is released by mothers nursing more pups than by mother nursing two (Kuo et al., 1962). It is of interest that the mother eat the placentas after delivery, otherwise, progesterone level in plasma are reduced (Grotta and Eik-Nes, 1967). It is interesting to note that in present investigation the parturient rats had a tendency to devour the placentae. Thus in nature, the female rats are eating the placentae to maintain desired level, natural level of progesterone in the plasma. The placental tissue devoured by the rat may be providing additional nutritional supply to meet the material loss of parturient mother.

The factors ultimately responsible for the steroids secreted by the ovary during lactation stages is undoubtedly the suckling stimulus. Suckling causes prolactin secretion and suppresses the secretion of the folliculotropins. The conditions of lactation in the rat are thus conductive to the secretion of progesterone by corpora lutea and the suppression of estrogen secretion by the remainder of the ovary (Rothchild, 1960 and Rothchild and Dickey, 1960).
In the mouse the corpora lutea of lactation at their maximum size (660 \( \mu \)) are smaller than corpora lutea of pregnancy at time of parturition (750 \( \mu \)) (Greenwald, 1958). The corpora lutea of lactation increase in size at day 11 one day later the vagina becomes fully mucified. During first half of lactation (10 days), progesterone and negligible amount of estrogen are present, as evidenced by vaginal histology. From 11th day onwards increasing level of estrogen are secreted in association with a significant increase in growth of antral follicles (Greenwald, 1958). While in present observation 15th and 17th day of lactation associated with significant increase in growth of antral preovulatory follicles (Fig. 4.1). Recently Hansockjee and Naikal (1955) while studying the onset of oestrus in lactating abino rats, observed the onset of oestrus on day 15 of lactation rats suckling 5 young. Though in *Rattus rattus rufescens* onset of second oestrus on 15th and 17th day of lactating rat suckling five young. It is not clear whether these effects of lactation on the attainment of maximum follicular size are due to suckling having different effects on gonadotrophic secretion or whether in different species follicles respond differently to gonadotrophins during lactation.

Post-partum oestrus occurs in the guinea pig with in 15 to 18 hours after parturition (Rowlands, 1956). The
corpora lutea of pregnancy show marked degeneration with in 16 days after parturition (Loeb, 1911). However, they persist as large structures for at least 15 to 19 days of lactation.

The corpora lutea of pregnancy in *Sus cuvieri* promptly degenerate with in 7 days after parturition (Sebnie, 1973).

In the rabbit post-partum ovulation does not normally occurs, but can induced by mating. The corpora lutea in contrast to condition in the rat or mouse, show a survival time inversely related to the size of the litter (Hamond and Marshall, 1925). They further observed that the degree of suckling stimulus determines whether functional corpora lutea are stimulated. Unlike the previous species post-partum oestrus does not occur in the hamster, parturition is accompanied by a rapid luteolysis, so that the corpora lutea are soon reduced to scattered remnants of connective tissue. Ovulation can be induced in the lactating hamster by a single injection of PMSG. However, the induced corpora lutea show sign of histologic regression within 4 to 7 days days after their formation (Greenwald, 1958).

The morphological changes in the ovary and in the
reproductive tract of lactating rat Rattus rattus rufescens can be accounted for by the following hypothesis.

As a result of the neuro-hormonal stimulus of suckling, the pituitary secretes sufficient prolactin to maintain functional corpora lutea of lactation. Progesterone, in turn prevents the release of gonadotrophin hormones from anterior pituitary. The follicles are therefore small and the secretion of estrogen is negligible during first half of lactation period. Between 15 and 17 days lactation for unknown reasons, the level of prolactin probably drops. Although the corpora lutea are still functional, progesterone decline sufficiently to permit the release of additional gonadotrophins. This leads to some increase in the size of the follicles and results in the accelerated secretion of estrogen. The secretion of prolactin probably drops even lower and final preovulatory growth of follicles can then occur.