BRIEF COMMUNICATION

FREQUENCY AND EXTENT OF DELAYED IMPLANTATION IN LACTATING RATS AND MICE

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Rats and mice ovulate and are receptive to males on the 1st or 2nd night following parturition. An animal may thus be pregnant while it is lactating, but implantation is often delayed (Lataste, 1891). In general, it appears that the length of the delay in implantation is correlated with the number of suckling young (Enzmann, Saphir & Pincus, 1932).

The data concerning delayed implantation in lactating rats and mice have been collected from relatively small numbers of experimental animals. The Charles River Breeding Laboratories, a commercial producer of rats and mice for scientific research, have made available to us breeding records of a larger population from which it is possible to estimate the frequency of delayed implantation and the length of the delay.

One pair of Charles River CD* rats (derived from Sprague-Dawley) or Charles River CD*-1 mice (derived from I.C.R. Swiss albino) was housed in each breeding cage. Since the male and the female remained together in the breeding cage even during parturition and lactation, there was maximal opportunity for mating to occur during the post-partum oestrus. Rat litters were removed from the cage at 21 days of age, and litters of mice at 19 days of age. The breeding record for each pair included, besides other information, the date of birth of each litter and the size of each litter. From the total days between births in a series of litters born to each pair, it is possible to calculate the approximate delay in implantation for each litter except the first and the last, provided the following assumptions are accepted: (1) Post-partum oestrus occurred the night following parturition (see Blandau & Soderwall, 1941). (2) The normal (non-lactating) gestation period averages 22 days for rats and 20 days for mice (see Eckstein & Zuckerman, 1956). (3) Parturition occurs 16 days following implantation in rats and 14 days following implantation in mice. (4) If mating did not occur during the immediate post-partum oestrus, it did not occur until after the litter was weaned. Thus in rats, for example, if parturition occurred 23 days following the previous parturition, it was assumed that mating occurred 22 days before parturition, and that implantation occurred 16 days before parturition, or on the 6th day of pregnancy. If the length of time between parturition was more than 41 days, it was assumed that mating did

* Trademark.
not occur at the time of the post-partum oestrus. If the length of time between parturitions was between 23 and 41 days, the day of pregnancy on which implantation was assumed to have occurred was the length of time between parturitions minus 16. For mice the calculations were adjusted for a gestation period of 20 days.

The breeding records of seventy-two pairs of rats having 277 litters resulting from post-partum matings were examined. For twenty-seven additional litters born to the same seventy-two pairs, a period of longer than 42 days between parturitions indicated that mating did not occur at the time of the post-partum oestrus or that the mating did not result in a pregnancy. The average gestation period following post-partum matings was 26.13 days. The estimated day of implantation for the 277 fertile post-partum matings is shown in Text-fig. 1. Implantation occurred on the 6th day in less than 10% of the pregnancies. Most of the pregnancies implanted between the 8th day and the 11th day of pregnancy. In approximately 10% of the pregnancies implantation occurred between the 14th and 21st day.

**Text-fig. 1.** Estimated day of implantation in 277 post-partum pregnancies in rats.

**Text-fig. 2.** Estimated day of implantation in 288 post-partum pregnancies in mice.
### Table 1

Relationship between the number of suckling young and delay of implantation

<table>
<thead>
<tr>
<th></th>
<th>Four or less young</th>
<th>Five to eight young</th>
<th>Nine to twelve young</th>
<th>Thirteen or more young</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Delay (days)</td>
<td>Delay (days)</td>
<td>Delay (days)</td>
<td>Delay (days)</td>
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<td>Pregnanacies (mean ± S.E.)</td>
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<td>Pregnanacies (mean ± S.E.)</td>
<td>Pregnanacies (mean ± S.E.)</td>
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<tr>
<td>Rats</td>
<td>17</td>
<td>56</td>
<td>128</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td>2·18 ± 0·92</td>
<td>3·68 ± 0·39</td>
<td>4·22 ± 0·23</td>
<td>4·76 ± 0·27</td>
</tr>
<tr>
<td>Mice</td>
<td>3</td>
<td>14</td>
<td>115</td>
<td>156</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>2·00 ± 0·43</td>
<td>4·09 ± 0·18</td>
<td>4·39 ± 0·20</td>
</tr>
</tbody>
</table>
The breeding records of fifty-six pairs of mice having 288 litters resulting from post-partum matings were examined. In eleven instances a period longer than 39 days between parturitions indicated that mating did not occur at the time of the post-partum oestrus or that the mating did not result in a pregnancy. The average gestation period following post-partum mating was 24.14 days. The estimated day of implantation for the 288 fertile post-partum matings is shown in Text-fig. 2. Implantation occurred on the 6th day in only a small percentage of the pregnancies. A delay of 1 to 7 days occurred in more than 90% of the pregnancies. In about 5% of the pregnancies the delay was 8 to 16 days.

The relationship between the size of the suckling litter and the delay in the concurrent pregnancy is indicated in Table 1. In rats, four or fewer suckling young resulted in an average delay in implanting of about 2 days. As the number of suckling young was increased, there was an increase in the delay of implantation. In general the findings were similar in mice, although there were too few litters of four or less to make an average meaningful.

Krehbiel (1941) suggested that the delay in implantation in lactating rats tended to fall into four definite periods related to the normal oestrous cycle of the rat. Bruce & East (1956) showed that such ‘implantation periods’ did not occur in mice, and Zeilmaker (1964) found no evidence of implantation periods in rats. The distribution of delays in implantation recorded in Text-figs. 1 and 2 of the present study provide further evidence that such implantation periods do not occur in either rats or mice.

The present study of a large population indicates that more than 90% of rats and mice have a delay in implantation when they are lactating. The observations of earlier workers concerning the relationship between the number of suckling young and the length of the delay in implantation is confirmed. In most of the rats and mice the delay is between 1 and 7 days, although in about 10% of both rats and mice implantation during lactation is delayed from 8 to 14 days.

The authors wish to express their appreciation to the Charles River Breeding Laboratories, North Wilmington, Massachusetts for making their breeding records available to us. Work done under Grant HD-01929-01 from the National Institute of Child Health and Human Development.

REFERENCES


Bruce, H. M. & East, J. (1956) Number and viability of young from pregnancies concurrent with lactation in the mouse. J. Endocr. 14, 19.


