Cognitive changes during pregnancy in female wistar rats

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Abstract-During pregnancy, a considerable number of women experience some degree of cognitive change that has come to be colloquially called “pregnancy brain” or “baby brain”, characterized by forgetfulness and memory disturbances. Studies investigating cognitive changes during pregnancy have been highly conflicting. The current study evaluated learning and memory using the elevated plus maze in non-pregnant and pregnant females at two time periods during pregnancy. Twenty (20) Wistar rats were used for this study, they were randomly assigned to three groups; non-pregnant female (n=6), and two pregnant groups of seven (7) animals each, one was evaluated for learning and memory on gestational day 11 and 12 and the other was evaluated on gestational day 18 and 19. Two females were mated by placing them with one sexually active male in one cage unit until the occurrence of spermatozoid in the vaginal epithelium determined by examination of vaginal smear. All females were returned to their home cages after mating. Day of conception was designated as gestational day zero. The findings showed that there was no significant change (p>0.05) in learning and memory in the pregnant group when compared to the non-pregnant group, although the non-pregnant group appeared to perform better in both activities but it was not statistically significant different (p>0.05) when compared to the control group. In conclusion, the results obtained from this study suggest that pregnancy does not have apparent effect on cognitive abilities in Wistar rats.

Key words: Cognition; conception; learning; mating; memory; pregnancy; rats

1. Introduction

Pregnancy produces alterations in maternal physiology. These changes may include physical, endocrine, and neurological alterations (1). Most prominent of these neurological alterations are concerns on memory deficit associated with pregnancy. Poser et al., (1986) (2) reported that about 80% of women experience cognitive deficits during pregnancy, including forgetfulness, reading difficulty, and poor concentration. Sharp et al., (1993) (3) also reported similar findings that about 81% of a sample of pregnant women complained of their memory being worse than normal. Many people have described these pregnancy associated memory losses as “baby brain”, “pregnancy brain”, “placenta brain” and “momnesia” (4,5). The little that is known about cognitive functioning during pregnancy both in humans and animal studies are highly conflicting. Although, many studies revealed no effect of pregnancy on cognition (6), others have demonstrated memory to be either enhanced or deteriorated (7, 8). In spite of all this evidence, much is still desired to be known. The current study sought to assess the influence of the stages of pregnancy on reference memory in Wistar rats using the elevated plus maze.

2. Materials and Methods

Care and management animals

Female albino Wistar rats between the ages of 14 - 16 weeks old and weighing between 150-200 g were procured from Department of pharmacology animal house. The animals were kept in well aerated laboratory cages in the Department of Human physiology animal house and were allowed to acclimatize to the laboratory environment for a period of one week before the commencement of the study. They were maintained on standard animal feeds and drinking water ad libitum during the acclimatization period.

Experimental protocol

Twenty (20) Wistar rats were used for this study, they were randomly assigned to three groups; non-pregnant female (n=6), and two pregnant groups of seven (7) animals each, one was trained and evaluated for memory on gestational day 11 and 12 and the other was evaluated on gestational day 18 and 19. Mating

Two females were mated by placing them with one sexually active male in one cage unit until the occurrence
of spermatozoid in the vaginal epithelium determined by examination of vaginal smear. All females were returned to their home cages after mating. Day of conception was designated as gestational day zero.

Evaluation of memory using elevated plus maze

Memory evaluation was conducted using elevated plus maze. The elevated plus maze was made from plywood, painted black and consisted of two open arms (21.5 x 7.5 cm) and two closed arms (21.5 x 7.5 x 20 cm) platform. The plus maze was elevated 38 cm from the ground. On the first trial (acquisition) rats was placed at the end of one open arm, facing away from the central platform. The time (second) taken for the rat to move from the open to one of the enclosed arms (transfer latency) was recorded. Following entry into the arm the animals were allowed to explore the apparatus for 30 seconds. Twenty four hours later the second trial (retention test) was performed and the transfer latency recorded (9).

Statistical analysis

Data was expressed as mean ± SEM and was analyzed by analysis of variance (ANOVA) and paired sample t-test using SPSS version 17.0. Values less than 0.05 were considered significant.

3. Results

Transfer latency to escape from the open arm to the closed arm during the memory (retention) test for the non-pregnant, 2nd trimester pregnant and 3rd trimester pregnant rats were 6.33 ± 2.11, 24.00 ± 11.48 and 18.71 ± 4.21 respectively (figure 1). The study revealed no significant difference in transfer latency (p > 0.05), although the non pregnant group performed better than the pregnancy groups. These results that stage of pregnancy did not affect memory.

Figure 2 depicts the difference between the first trial (acquisition) and second trial (retention test) for each of the groups. Paired sample t-test showed no significant change in all groups when both trials were compared.

Figure 1: Transfer latency of Wistar rats during retention(memory) test
Figure 2: Comparison of transfer latencies (seconds) between the day of training and retention

4. Discussion

In this study, evaluation of memory was based on stereotyped aversion of rodents to open spaces. The ability to recall is indicated by shortened transfer latency; time taken for the animal to find the closed arm of the maze. Recall (or retrieval) involves orienting in a familiar environment and navigating to the platform and is reflected in an ability to locate the platform more quickly, traveling shorter distances, with increased experience over trial-days. No difference was observed between the non-pregnant group and the pregnant groups (2nd and 3rd trimester) in the time required to locate the closed arms, there was also no significant difference in the transfer latency in the first trial (acquisition) and the second trial (retention test). However, the non-pregnant rats showed shortened transfer latency in the retention test compared to the pregnant groups, though difference was not significant, this may suggest that pregnancy can impair spatial memory ability but it might not be significant enough to cause serious harm. These findings uphold previous reports by Bodensteiner et al., (2006) (6) who reported that pregnancy had no apparent influence on cognition. It also opposes the findings of Galea et al., (2000) (7) who observed that cognitive performance of pregnant rats during the first and second trimester was enhanced when compared to non pregnant rats. In addition pregnant rats in the third trimester performed poorly compared to non pregnant rats (7). This cognitive changes was potentially attributed to levels of estradiol, progesterone, and corticosterone during pregnancy, with estradiol and corticosterone having an inhibitory effect of performance and progesterone having a facilitatory effect on performance. Though hormonal assessment was not done in this study, estrogen and progesterone have been shown to increase memory deficit considering the dramatically increase in their concentrations from early to late pregnancy (10). Furthermore, modifications of cognitive function occur under the influence of the drastic changes in the hormones occurring during pregnancy (11). The mild deficit in cognitive abilities may be related to the hormonal alterations that accompany pregnancy.

5. Conclusion

In conclusion, the results obtained from this study suggest that memory deficits were found although it was not significant. This data also confirms past reports that pregnancy has no significant negative impact on cognitive performance and ability. Further studies are current going on in our neurobehavioural laboratory in order to elucidate the hormonal alterations and its correlation with cognitive and behavioural responses during different stages of pregnancy.

References


