

Summary

This study was carried out during the period from October 2014 to April 2015 on a total number of 100 female and 23 male wistar rats which were used for breeding to obtain a total number of 483 neonates which were the subject of this study to investigate effects of environmental enrichment on the improvement of the laboratory animal welfare.

The results showed that:

Effect of prenatal and postnatal enrichment on ingestive behaviour of rat neonates

Feeding behaviour was significantly ($P < 0.01$) decreased in duration in E+EC and enriched groups in comparison with control group.

Effect of prenatal and postnatal enrichment on comfort, body care (grooming) and enrichment-directed behaviour of rat neonates

Sleep behaviour was significantly ($P < 0.01$) decreased in duration and frequency in E+EC group in comparison with other groups, while grooming duration and frequency were significantly ($P < 0.05$) increased in control group in comparison with enriched group while increased only in frequency in control (standard) group in comparison with E+EC group. In addition enrichment-directed behaviour rats in E+EC group spent large part of time interacting with various enrichment tools.

Effect of prenatal and postnatal enrichment on exploratory and playing behaviour of rat neonates

Play and fighting behaviour were significantly ($P < 0.05$) increased in duration in enriched group in comparison with other groups.

Effect of prenatal and postnatal enrichment on behaviour of rat neonates in elevated plus maze

The time spent in open arm ($P<0.05$) and USAP frequency ($P<0.01$) was significantly increased in E+EC group in comparison with enriched group. In addition the open arm entries were significantly increased in E+EC in comparison with control (standard) group ($P<0.05$) and enriched group ($P<0.01$), and time in center was significantly ($P<0.05$) increased in E+EC group in comparison with control (standard) group.

Effect of prenatal and postnatal enrichment on behaviour of rat neonates in open field test

Freezing time was significantly decreased in enriched ($P<0.01$) and E+EC ($P<0.05$) groups in comparison with control (standard) group. In addition grooming frequency was significantly ($P<0.05$) increased in E+EC group in comparison with other groups.

Effect of prenatal and postnatal enrichment on corticosterone level ($\mu\text{g}/\text{dl}$) of rat neonates

Corticosterone level was significantly ($P<0.05$) decreased in E+EC group in comparison with control (standard) group.

Effect of prenatal and postnatal enrichment on the spine density of hippocampal neurons of rat neonates

The mean of tertiary processes in each secondary process of cytoplasmic processes in cross section of hippocampal region (spine density) were significantly ($P<0.05$) increased in E+EC group in comparison with control (standard) group.

Effect of prenatal and postnatal enrichment on ingestive behaviour of prenatally stressed rat neonates

Feeding ($P<0.01$) and drinking ($P<0.05$) behaviour were significantly increased in PS-EC group in comparison with PS and PS+E groups with group.

Effect of prenatal and postnatal enrichment on comfort, body care (grooming) and enrichment-directed behaviour of prenatally stressed rat neonates

Sleep behaviour were significantly ($P<0.01$) increased in Ps and PS+E groups in comparison with PS-EC and PS+E-EC groups, while grooming behaviour was significantly ($P<0.05$) decreased in frequency in PS group in comparison with other groups.

Effect of prenatal and postnatal enrichment on exploratory and playing behaviour of prenatally stressed rat offspring

The exploration by walking was significantly ($P<0.05$) increased in PS+E-EC and PS-EC groups in comparison with PS and PS+E groups, while play and fight behaviour were significantly ($P<0.05$) increased in duration in PS+E group in comparison with other groups.

Effect of prenatal and postnatal enrichment on behaviour of prenatally stressed rat offspring in elevated plus maze

The SAP time were significantly ($P<0.05$) increased in Ps-EC group in comparison with PS group, while number of fecal boli ($P<0.01$) and time in center ($P<0.05$) was significantly increased in PS group in comparison with other groups.

Effect of prenatal and postnatal enrichment on behaviour of prenatally stressed rat offspring in open field test

Freezing time was significantly ($P<0.05$) increased in PS group in comparison with PS+E-EC, while the number of peripheral square crossing was significantly ($P<0.05$) decreased in PS group in comparison with other groups. However the number of central squares crossing was significantly ($P<0.05$) increased in PS+E-EC in comparison with other groups. In addition central square duration was significantly ($P<0.05$) increased in PS+E-EC in comparison with PS group. Moreover grooming duration was significantly ($P<0.05$) increased in PS group in comparison with PS+E group and rearing was significantly increased in PS+E-EC and PS-EC group in comparison with PS+E ($P<0.05$) group and PS ($P<0.01$) group.

Effect of acute prenatal stress with or without enrichment on the neutrophil (%), lymphocyte (%) and neutrophil/lymphocyte ratio (N/L)

The neutrophil% and neutrophil\lymphocyte ratio were significantly ($P<0.05$) decreased, and lymphocyte% was significantly ($P<0.05$) increased in prenatally stressed dams after a period of restraint stress during last week of gestation in comparison with control and prenatal stress+ Enrichment dams.

Effect of acute prenatal stress with or without enrichment on the amount of total protein, total albumin, total globulin and corticosterone level in pregnant rats and rat neonates

The amount of total protein were significantly ($P<0.05$) decreased, while corticosterone level significantly ($P<0.05$) increased in prenatal stressed rats after a period of restraint stress during last week of gestation in comparison with control and prenatal stress+ Enrichment rats. Meanwhile the corticosterone level was higher in

prenatally stressed rat neonates in comparison with other groups but not statistically significant.

Effect of prenatal and postnatal enrichment on the spine density of hippocampal neurons of prenatally stressed rat neonates

The mean of tertiary processes in each secondary process of cytoplasmic processes in cross section of hippocampal region (spine density) was lower in prenatal stress group and relatively higher in other groups which exposed to enrichment but not statistically significant.

Effect of postnatal enrichment on ingestive behaviour of rat neonates exposed to maternal deprivation

No significant difference in feeding behaviour between different groups, while drinking frequency was significantly ($P<0.05$) increased in MS and MS+E groups in comparison with MR+E.

Effect of postnatal enrichment on comfort, body care (grooming) and Enrichment-directed behaviour of rat neonates exposed to maternal deprivation

Sleep behaviour was significantly ($P<0.05$) increased in MR and MS groups in comparison with MS+E group, in addition grooming behaviour was significantly ($P<0.05$) increased in frequency in MS group in comparison with MR+E group as well as enrichment directed behaviour was significantly ($P<0.05$) increased in frequency in MS+E group in comparison with MR+E group.

Effect of postnatal enrichment on exploratory and playing behaviour of rat neonates exposed to maternal deprivation

The exploration against cage was significantly ($P<0.05$) increased in MS+E group in comparison with MR+E group, while exploration outside cage was

significantly increased in MS group in comparison with MS+E ($P<0.05$) group and with MR+E group ($P<0.01$).

Effect of postnatal enrichment on behaviour of rat neonates exposed to maternal deprivation in elevated plus maze

The time spent in closed arm and closed arm entries were significantly ($P<0.05$) decreased in MR group in comparison with other groups, However time in center was significantly ($P<0.05$) increased in MR group in comparison with other groups.

Effect of postnatal enrichment on behaviour of rat neonates exposed to maternal deprivation in open field test

The number of peripheral and central square crossing were significantly ($P<0.05$) increased in MS+E group in comparison with other groups, while central square duration was significantly ($P<0.05$) increased in MS+E group in comparison with MR group. It was clear that freezing time ($P<0.01$) and stretch attend posture ($P<0.05$) were significantly increased in MS group in comparison with other groups. In addition grooming duration was significantly ($P<0.05$) increased in MR group in comparison with other groups, while rearing was significantly ($P<0.05$) decreased in MR group in comparison with other groups.

Effect of postnatal enrichment on corticosterone level ($\mu\text{g}/\text{dl}$) of rat neonates exposed to maternal deprivation

The level of corticosterone was significantly ($P<0.01$) increased in MS group in comparison with MR and MR+E groups and was significantly ($P<0.05$) increased in MS group in comparison with MS+E group.

Effect of postnatal enrichment on dendritic branching of hippocampus of rat neonates exposed to maternal deprivation

From **photos: (3, 4, 5 and 6)** it was clear that MS group showed normal distribution of the cytoplasmic processes of neurons and neuroglia cells, while MS+E group showed extensive cytoplasmic processes with a marked increase in the size of neurons and neuroglia cells. However MR and MR+E groups were nearly similar showing normal distribution of the cytoplasmic processes of neurons and neuroglia cells.