Impact of social housing and social separation on haematological and physiological parameters in Syrian male hamsters

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Abstract

Syrian hamsters have been used as an animal model in different branches of medical sciences and veterinary sciences since 1930. This is partly because many aspects of their physiology are more similar to those of humans than many other laboratory animals. A socially bonded pair of hamster is the best animal model to study the circadian rhythm and anxiolytic drugs. A trial was conducted at Biogen Animal Facility, Bangalore to assess the haematological and physiological effects of Syrian hamsters in social housing versus social separation. Forty hamsters (20 males and 20 females) were randomly housed in pairs in 10 replicates and one control group with 10 replicates in polycarbonate cage with wire grid lids, corn cob litter material and soft nesting material. The social separation was not done in the control group till the end of the study. Blood collection from the orbital sinus was done at the end of social housing and at the end of social separation from male hamsters. Serum cortisol, total leukocyte count (TLC) count, differential count, platelet and packed cell volume were analyzed. The results indicated that socially separated males had significantly ($P \leq 0.05$) higher serum cortisol levels than socially housed and control groups. There was higher significant difference ($P \leq 0.01$) in haemoglobin, TLC and PCV of socially separated males over socially housed males and control group males, whereas; there was no significant difference found in platelets count in all the groups. There was a marked reduction in the activity of socially separated male hamsters than socially housed.

Key words: Cortisol, Hamster, Social housing, Social separation, Stress

INTRODUCTION

Syrian hamsters have been used as an animal model in different branches of research in medical and veterinary sciences since 1930 (Valentine *et al.*, 2012). Since many aspects of their physiology are more similar to those of humans than other laboratory animals (Ross *et al.*, 2017). It has also been reported by Ross *et al.* (2017) that social housing followed by social separation causes anxiety-induced anorexia and reductions in body weight selectively in females. It has also been reported that socially bonded pair of hamsters are the best animal model to study the circadian rhythm and modern anxiolytic drugs (Shannonhouse,

2017). In addition, hamsters, like humans, are dual secretors of cortisol and corticosterone (Solomon *et al.*, 2011). Cortisol is more labile in response to circadian rhythm and different types of stress like managemental and environmental (Clifford and Summons, 2017). This pattern of response is in marked contrast to most laboratory rodents, which primarily secrete corticosterone, and suggests that hamsters are an ideal species for stress/antidepressant drug research. The objective of this experiment was to determine the haematological and physiological effects of Syrian male hamsters in social housing as compared to social separation.

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MATERIALS AND METHODS

A trial was conducted at Biogen Animal Facility, Bangalore, in the year 2018 with an objective to assess the haematological and physiological effects of Syrian hamsters in social housing as compared to social separation. Forty hamsters (20 males and 20 females) in pairs were randomly housed in 10 replicates as T_1 (social housed males) for four weeks, whereas same males considered as T_2 after social separation from females. The control group (T_3) with 10 replicates in polycarbonate cages (23 x 43 x 20 cm) with wire grid lids, corn cob litter material and soft nesting material. The social separation was not done in the control group till the end of the trial. Feed-in pellet form and reverse-osmosis-purified water was made available *ad libitum*. The room was maintained on a 14:10 light: dark cycle at $23\pm3^\circ\text{C}$, as it is mandatory with hamsters to maintain the photoperiodic control on gonadal hormones. All procedures were approved by the Institutional Animal Ethical Care Committee and were in accordance with the standards outlined in the CPCSEA. Male hamsters were separated from each cage after 4 weeks and reared in isolation for another 4 weeks except in the control group paired hamsters.

The hamsters were anesthetized by isoflurane inhalation anesthetic and 1 mL blood was collected from the orbital sinus (Popesko *et al.*, 1992) on the last day of social housing and social separation of the trail. Serum cortisol was measured with an enzyme-linked immunosorbent assay following the manufacturer's instructions (Sigma-Aldrich). The differential count like neutrophils, lymphocytes, eosinophils, monocytes, myelocytes, basophils and band form and haemoglobin, total leukocytes count (TLC) count, platelet count and packed cell volume (PCV) was measured by calibrated SYSMEX poch-100i fully automated analyzer.

Statistical analysis method: The descriptive statistics for haematological and physiological effects were analyzed using SPSS version 16.0. One way ANOVA was carried out to study the

impact of social housing and social separation on cortisol, TLC count, differential count, haemoglobin, platelet and packed cell volume in Syrian male hamsters.

RESULTS

Impact of social housing and social separation on cortisol, total count, differential count, platelet and packed cell volume in Syrian hamsters are given in Table 1. The mean haemoglobin (%), TLC count (cells/ μL), platelet count (lakhs/ μL) and PCV (%) of socially housed group hamster males were 16.9, 4270, 4.16 and 47.59 respectively, whereas, it was 15.79, 5220, 4.78 and 43.90 respectively in socially separated group hamster males. There was a higher significant difference ($P\leq 0.01$) in haemoglobin, total count and PCV of socially separated males over socially housed males and control group males whereas, there was no significant difference found in platelet count in all the groups. The average neutrophils (%), lymphocytes (%) and eosinophils (%) of socially housed hamster males were 70.2, 25.3 and 2.2 respectively; whereas it was 76.5, 21.0 and 1.2 respectively in socially separated hamster males. There was higher significant difference ($P\leq 0.01$) in average neutrophils (%), lymphocytes (%) and eosinophils (%) of social separated males over socially housed males and control group males. The present study did not find monocytes, myelocytes and basophils in Syrian hamster blood; however band form was in the normal range in all the groups. The mean serum cortisol ($\mu\text{g/dL}$) of socially housed and socially separated male hamsters was 0.750 and 1.132, respectively. There was higher significant difference ($P\leq 0.05$) in mean serum cortisol ($\mu\text{g/dL}$) of social separated males over socially housed males and control group males.

DISCUSSION

The haematological values were in the normal range as per previous studies (Moore, 2000; Provencher *et al.*, 2010; Smith *et al.*, 2010; Clifford, 2017), however there was no previous research work done on the impact of

Table 1. Comparative statement of haematological parameters and serum cortisol ($\mu\text{g/dL}$) of Syrian hamsters in socially housed and socially separated groups

Hematology parameters	Social housing	Social separation	Control	P Value
Hemoglobin (%)	16.9 ^A ±0.27	15.79 ^B ±0.25	16.2 ^A ±0.24	0.008
TLC count (cells/ μL)	4270 ^B ±62.95	5220 ^A ±208.24	4300 ^B ±75.25	0.007
Platelet count (lakhs/ μL)	4.16±0.26	4.78±0.19	4.25±0.31	0.061
PCV (%)	47.59 ^B ±0.75	43.9 ^A ±0.63	46.52 ^B ±0.65	0.008
Neutrophils (%)	70.2 ^B ±1.10	76.5 ^A ±0.54	71.2 ^B ±1.25	0.004
Lymphocytes (%)	25.3 ^A ±0.96	21.0 ^B ±0.44	25.6 ^A ±0.12	0.009
Eosinophils (%)	2.2 ^A ±0.14	1.2 ^B ±0.14	2.1 ^A ±0.08	0.007
Monocytes (%)	00	00	00	—
Myelocytes (%)	00	00	00	—
Basophils (%)	00	00	00	—
Band form (%)	1.1±0.10	1±0.0	1±0.0	0.125
Serum Cortisol ($\mu\text{g/dL}$)	0.750±0.21 ^b	1.132±0.29 ^a	0.319±0.04 ^c	0.026903

A, B - Means bearing different superscripts within rows differ significantly* (Pd''0.01)

a, b - Means bearing different superscripts within rows differ significantly* (Pd''0.05)

social housing and social separation on haematological parameters in Syrian male hamsters. Provencher *et al.* (2010) reported about rare occurrence of monocytes, basophils and myelocytes. Band forms are generally observed during inflammation in Syrian hamster (Moore, 2000). When male hamsters were separated into individual cages after previous paired housing during development, the animals may experience some stress due to the change in housing. The results of the serum cortisol in this study are in agreement with (Meisel *et al.*, 1990) who reported similar findings. In contrast to this, Ross *et al.* (2017) reported socially housed and socially separated Syrian hamsters had similar serum cortisol levels. Perhaps the most surprising conclusion that can be drawn from the present data is that male Syrian hamster is not able to adapt well to social isolation, however Ross *et al.* (2017) concluded that both male and female Syrian hamsters were adapted well in social housed and social separation. Lindstrom *et al.* (2015) reported that acute stress in hamsters results in elevated serum cortisol but normal neutrophil/lymphocyte ratio, whereas distress decreases the serum cortisol concentrations with an elevated neutrophil/lymphocyte ratio. However, other studies reported that neutrophilia and lymphopenia

were seen in chronically stressed laboratory animals. Yoganathan *et al.* (1998) reported that stress induced by feed modification enhances cholesterol and triglyceride level in group housed hamsters than individually housed hamsters, although Smith *et al.* (2010) found a similar effect in young Syrian hamsters. Weinberg and Wong, (1986) reported that housing hamsters in unfamiliar environment will increase cortisol level whereas, King-Herbert *et al.* (1997) found no difference in serum cortisol level in hamsters housed in unfamiliar environment. Huhman *et al.* (1991) concluded that male hamsters housed with ovariectomized female hamster will induce significant increase in blood adrenocorticotrophic hormone (ACTH) and cortisol level.

The result of the present study indicates that even though Syrian hamsters may be naturally solitary animals, they are not able to adapt to social isolation in the laboratory environment. The separation causes stress in the male hamsters, which makes this animal as a good model for behavioral studies for humans affected with a mood disorder. It is also evident that socially separated males have significantly increased serum cortisol level and significant deviation of haematological parameters than socially housed male Syrian hamsters.

Conflict of interest: Authors have no conflict of interest in this study.

Author's contribution: AK: Has substantial contribution to the conception and design, the acquisition of data, statistical analysis of data and interpretation of the results or drafting or critically revising the manuscript; YBR & VMP: Were mentoring and drafting or critically revising the manuscript; RRY, SMA, SGS, SKB, AKR, MKD and PK: Had substantial

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