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Research Article

Blood pressure and heart rate during adaptation in ICR male mice

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Abstract
The blood pressure in male mice were measured at 16h, and 14, 28, 40 days after adaptation, where the standard was six days after shipping in ICR male mice. The experimental group was delivered overnight, for period of 16 hr. After 16hr from transport, the blood pressure was significantly higher than 14 and 40 days. Furthermore, 28 days after shipping, we recorded mid hypertension in ICR male mice. Systolic blood using the tail-cuff method, mice had significant mild high blood pressure. Experimental group adapted for 14 days after shipment, second for 28 days after transportation, and third until 40 days after transportation. Systolic blood pressure in the experiment group was 135±0.8mm Hg one week after delivery. Because this was far greater than previously reported for this strain, acclimatization took longer. Systolic blood pressure was measured 40 days after shipment was 120±0.03mm Hg. Throughout this time, heart rate also dropped from 531±0.5 in the experimental group to 380±0.2bpm in 40 days (P<0.05). Systolic blood pressure in the two control groups was also lower than in the experiment group 14 and 28 days after shipment.

Keywords: Blood pressure, Adaptation, Experiment, ICR.

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Introduction

Many hypertension researchers use mice but mostly males to assess the blood pressure on a regular basis (Fox et al. 2007). Most institutional animal care committees recommend allowing the mice to adapt for one week following shipping as a general rule (Capdevila et al. 2007). One study found that three days of acclimatization was sufficient, as heart rate, body weight, and activity are returned to normal conditions (Feng et al. 2008, 2009). In this report, we present our findings regarding the blood pressure in ICR mice during the 16h, and 14, 28, 40 days acclimation period.

Material and methods

A total of 20 ICR male mice (with 1 month age and weight of 18±0.3–22±0.5g) were obtained from private animal's laboratory (UPM) and transferred to the animal house in the veterinary medicine department, University of UPM overnight (16h, 65km). Within 16 hours, their blood pressure was measured as non-invasive. The second group of ICR mice with the same shipping data but in different determent date were adapted for 14 and 28 days and it extended to 40 days for the same number of mice. The blood pressure was recorded in the two control groups with similar ages and sex. Ten mice per cage

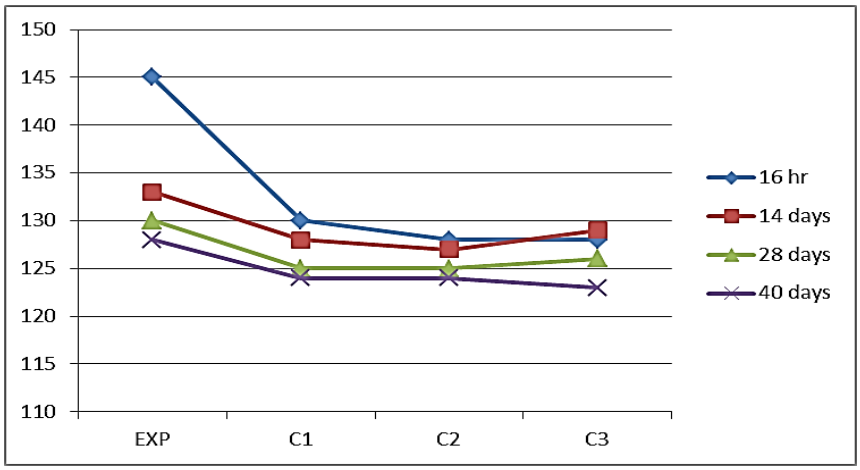

Fig.1. Systolic blood pressure mmHg values (Mean ± SE) (n=10) different adaptation.

were housed in the same day and night cycle at room temperature after ensuring a peaceful environment. Through everyday inspections, all mice were in good health, with no signs of fighting or discomfort.

Tests of the blood pressure: The researchers use a proven Coda (tail-cuff approach) that depends on volumetric pressure recording device to quantify systolic blood pressure (SBPs) (Coda 5; Cent scientific company, Germany, CT). Every day, the same experienced operator measured 4 SBP at the same time. The baseline systolic blood pressure was measured once all mice had been habituated to the systolic blood pressure examinations for six days. The baseline SBP was then measured as the mean of the three days. Furthermore, the average SBP of each day was calculated by averaging ten acclimation cycles and fifteen measurement cycles. Even during three testing days, there was no decrease in SBP, indicating that no more adaptation occurred. For comparison of the mean between groups, we used T-test analysis by considering significance at 0.05.

Results

Systolic blood pressure in the experimental groups was substantially elevated for all mice during 14 days after transport as 130±0.04smmHg (Fig. 1). During 14 days following delivery, the mice did not gain weight (18±0.3 - 22±0.5g). Systolic blood pressure had dropped to 123mm Hg in about 6 weeks after transport ($P \leq 0.05$) than mean systolic blood pressure at 16hr, 14 and 28 days. The control group's mean systolic blood pressure after 40 days of adaptation was lower than the experiment group's mean systolic blood pressure after 14 days (135±0.8 vs. 123±0.3, $P \leq 0.05$) (Fig. 1). The mean heart rate also dropped from 531±0.5 to 380±0.2bpm over this time ($P \leq 0.01$). Additionally, 14 days after adaptation, the mean systolic blood pressure of the mice was significantly decreased than other groups (129±0.4 vs. 135±0.8, $P \leq 0.05$) (Fig. 1). Systolic blood pressure was slightly but not significantly higher 16hr after delivery in the male mice compared to 40 days after transport (126±0.5 vs. 135±0.8).

Discussion

In this study, in ICR male mice the blood pressures were monitored for at least one week after shipment. Their systolic blood pressure decreased 40 days after transport. Systolic blood pressure was somewhat higher in groups that had been acclimated for 16hr, 14 and 28 days, but these groups were significantly higher than in mice that had been compared for 40 days after transport. These findings were made with male mice, which are extensively utilized in animal studies (Feng et al. 2008). The higher blood pressures can be caused by environmental factors during shipment (D'Angelo et al. 2005)[5].

The experiment and control groups of male mice

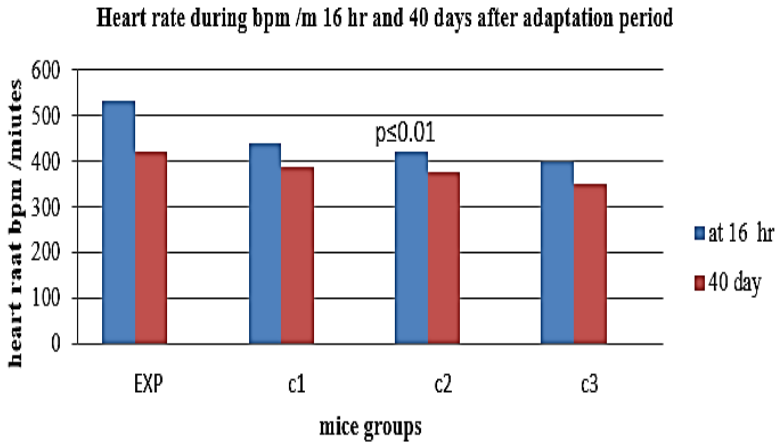

Fig.2. Heart rate bpm/m n=10 (Mean ± SE) during 16 hr. after transport and 40 days housed mice.

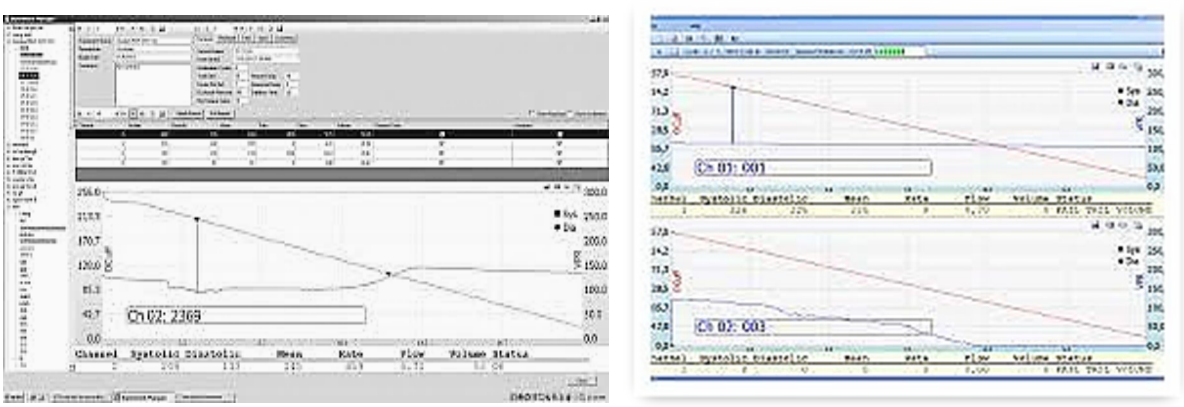

Fig.3. Protocol blood pressure measurement in male mice.

were transported separately. The experiment group's shipment may have been more stressful, since it resulted in increased blood pressure following delivery. The systolic blood pressure in a group of mice was still high after 40 days of adaptation showing that the blood pressure during adaptation was ineffective. Blood pressure measurements using a tail-cuff approach depends on plethysmography, e.g. it revealed that a high fructose diet caused hypertension in rats, but telemetry could not confirm it (Olfe et al. 2010). Conversely, our in-house mice were not hypertensive despite the fact that tail-cuff blood pressure was measured (Bean-Knudsen, D.E. & Wagner 1987). Therefore, the influence of the blood pressure measuring method seems less likely affect the results. Tail-cuff blood pressures were taken according to the protocol for a three-day acclimatization period before beginning "official" readings (Pickering et al. 2008) [8]. In a recent study, male mice showed a higher stress reaction than in0house mice (Bean-Knudsen, D.E. & Wagner 1987).

For up to 40 days following transport, in the male mice, glucocorticoid levels are raised and monoaminergic activity is enhanced (Pickering et al. 2008). It is possible that an activated neuroendocrine system contributes to elevated blood pressure upon shipping[8]. Another study found that white blood cells, electrolytes, and enzymes in rats immediately after shipping differed significantly from rats who were permitted to roam freely (Olfe et al. 2010).

In conclusion, vendor-derived mice are hypertensive one week after shipping, become normotensive after three weeks, and do not recover

to in-house levels until six weeks. As a result, mice must be given at least 3 weeks to adapt after shipping. It will be interesting to discover if this shipping-related increase in blood pressure is found in other mouse strain and if the same results are achieved using a different blood pressure measurement technique, such as telemetry. Designing and carrying out investigations that have included measurement in mice, for the high blood pressure scientific community.

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