Blood volumes in inbred rat strains with different survival times after severe hemorrhage

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The use of Army medical and/or other Army records in the preparation of this material is acknowledged, but is not to be construed as implying official Department of the Army approval of the conclusions presented.

Introduction

We have previously shown 8-fold differences in survival time among inbred rat strains after a 55% hemorrhage, and found a strong genetic component for this trait (Klemcke et al., *Shock* 29: 748, 2008). Blood volumes for all strains were assumed to be 5.83% of body weight (BW), and blood volumes removed were based on this figure. However, blood volume might vary among rat strains. If true, this may be one genetic variable affecting survival time after hemorrhage. To examine this possibility, we measured blood volumes in specific inbred rat strains divergent in survival time using an Evans blue dye procedure.

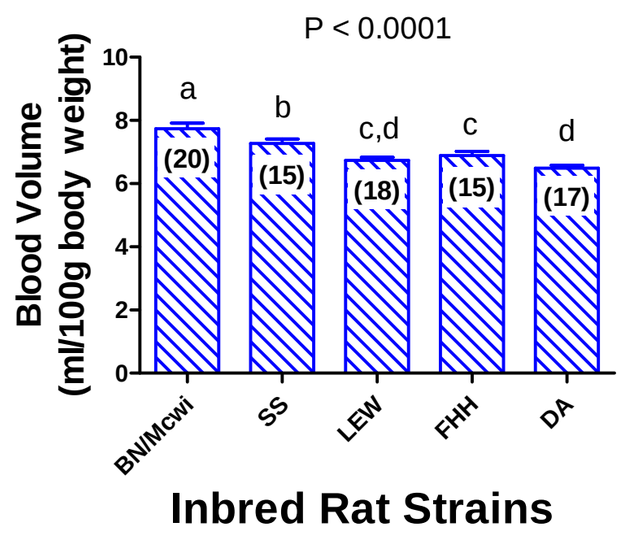
Methods

- Male rats [n = 15-20/strain; Brown Norway/Medical College of Wisconsin (BN/Mcwi), Salt Sensitive (SS), Lewis (LEW), Fawn Hooded Hypertensive (FHH) and DA] were catheterized in the carotid artery while under isoflurane anesthesia.
- The right femoral vein was also isolated.
- A 500 µl blood sample was taken *via* the carotid artery, and subsequently a 0.5% solution of Evans blue dye (100 µl / 100 gram BW) was injected into the femoral vein.
- Five minutes later a second 500 µl blood sample was taken.
- Plasma was obtained from blood *via* centrifugation and 50 µl of plasma was diluted to 1 ml using sterile 0.9% sodium chloride solution.
- Absorbancy was measured at 605 nm.
- Hematocrits were measured and used in the calculation of blood volumes (Wang, *Am J Physiol* 196: 188, 1959).

Results

- Blood volumes differed (P<0.001) among inbred rat strains (Fig 1).
- A heritability (h^2, proportion of phenotypic variance that is genetic) of 0.68 for blood volume was calculated (Hegmann and Possidente, *Behavior Genetics* 11: 103, 1981).
- If measured blood volumes are used to calculate the percent of blood actually removed in these same rat strains for our previous study, then there was a negative correlation between the percent of blood volume removed and the measured survival time
- (r = -0.75; P <0.0001)

Figure 1



Bars represent means ± SEM. The number of rats for each mean are noted in parentheses. Bars that share a common letter superscript are not different P>0.05.

Conclusions

- In our previous study, rats of different strains were subjected to hemorrhages of different severity.
- Previously measured differences in survival time among inbred rat strains might be accounted for—in part—by differences in blood volumes.
- The high heritability of blood volume indicates a trait that is under genetic control.
- We may have found one genetically-controlled characteristic (blood volume) associated with survival time after hemorrhage that is amenable to environmental (Convertino et al., *J Appl Physiol* 48: 657, 1980) and genetic manipulation.